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TRANSACTIONS

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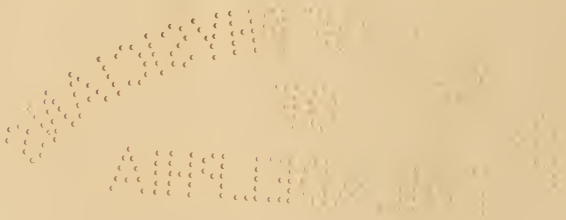

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Erratum.—Page 202, eleventh line from top of page, *for* "catgut" *read* "silk."

LIST OF OFFICERS.

[Elected May 3, 1900.]

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1901. A. J. GILLETTE, M D.

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1892. Blanchard, Wallace, M.D. Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 34 E. Monroe Street, Chicago.

1889. Brackett, E. G., M.D. Assistant Surgeon to the Children's Hospital. 133 Newbury Street, Boston.

*1887. Bradford, E. H., M.D. Visiting Surgeon to the Children's and the Good Samaritan Hospitals; Assistant Professor of Orthopedic Surgery in Harvard Medical School. 133 Newbury Street, Boston.

1889. Burrell, Herbert L., M.D. Visiting Surgeon to the Boston City Hospital; Visiting Surgeon to the Children's Hospital; Assistant Professor of Clinical Surgery, Harvard University. 22 Newbury Street, Boston.

1891. Cook, Ansel G., M.D. Orthopedic Surgeon to the Hartford Hospital. 164 High Street, Hartford, Conn.

1893. Coolidge, Frederic S., M.D. Demonstrator of Surgical Appliances in Rush Medical College; Professor of Orthopedic Surgery, Chicago Post-Graduate Medical College; Attending Orthopedic Surgeon to the St. Luke's and St. Elizabeth's Hospitals; Attending Physician to Children, Presbyterian Hospital. 103 State Street, Chicago.

1895. Dane, John, M.D. Junior Assistant Surgeon to the Children's Hospital; Assistant Surgeon to the West End Infant Hospital. 29 Marlborough Street, Boston.

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1900. Elliott, George R., M.D. Orthopedic Surgeon of Montefiore Home for Chronic Invalids. 48 East 26th Street, New York.

*1887. Foster, Charles C., M.D. Orthopedic Surgeon to the Cambridge Hospital; Visiting Physician to the Avon Home for Children; Visiting Physician to St. Luke's Home for Children. 8 Elwood Avenue, Cambridge, Mass.

1899. Galloway, H. P. H., M.D. Surgeon to the Toronto Orthopedic Hospital; Orthopedic Surgeon to the Toronto Western Hospital; Orthopedic Surgeon to Grace General Hospital, Toronto. 12 East Bloor Street, Toronto, Canada.

*1887. Gibney, V. P., M.D. Clinical Professor of Orthopedic Surgery in the College of Physicians and Surgeons, Medical Department of Columbia University; Surgeon-in-Chief to the New York Hospital for Ruptured and Crippled; Orthopedic Surgeon to the Nursery and Children's Hospital and to the Montefiore Home and Hospital, New York. 16 Park Avenue, New York.

*1889. Gillette, Arthur J., M.D. Professor of Orthopedic Surgery in the Minnesota State University; Orthopedic Surgeon to St. Luke's, St. Joseph's, Bethesda, City and County Hospitals, and the St. Paul Free Dispensary, and Consulting Orthopedic Surgeon to Asbury Hospital; Surgeon in charge of Minnesota State Hospital for Crippled and Deformed Children. 301 Pleasant Avenue, St. Paul, Minn.

1892. Goldthwait, Joel E., M.D. Orthopedic Surgeon to Carney Hospital; Consulting Orthopedic Surgeon to the Massachusetts General and the New England Hospitals; Assistant Surgeon to the Children's Hospital. 372 Marlborough Street, Boston.

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1898. Hoffmann, Phil., M.D. Clinical Lecturer on Orthopedic Surgery in the Medical Department Washington University; Chief of the Orthopedic Clinic at St. John's Hospital. 705 North Channing Avenue, St. Louis, Mo.

1899. Hopkins, W. Barton, M.D. Visiting Surgeon to the Pennsylvania Hospital. 1904 South Rittenhouse Square, Philadelphia.

1893. Hosmer, A. B., M.D. Orthopedic Surgeon to St. Luke's Hospital. 103 State Street, Chicago.

1893. Hubbard, Le Roy W., M.D. Attending Surgeon for Orthopedic Cases at the Randall's Island Hospitals. 70 West Thirty-fifth Street, New York.

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1893. Plimpton, W. O., M. D. Instructor in Orthopedic Surgery, Post-Graduate Medical School and Hospital; Assistant to the Chair of Orthopedic Surgery, University Medical School; Visiting Surgeon to the Post-Graduate Hospital, New York. 40 West Thirty-fourth Street, New York.

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1889. Weigel, Louis A., M.D. Professor of Orthopedic Surgery in the Medical Department of Niagara University, Buffalo; Orthopedic Surgeon to Rochester City Hospital and Out-patient Department; Consulting Orthopedic Surgeon to Provident Dispensary. 209 East Avenue, Rochester, N. Y.

1890. Whitman, Royal, M.D. Instructor in Orthopedic Surgery and Chief of the Orthopedic Division of the Vanderbilt Clinic in the College of Physicians and Surgeons; Adjunct Professor of Orthopedic Surgery in the New York Polyclinic; Assistant Surgeon to the Hospital for Ruptured and Crippled, New York. 126 West Fifty-ninth Street, New York.

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1893. O. LANNELONGUE, Professeur à la Faculté de Médecine de Paris (Chaire de Chirurgie); Membre de l'Académie de Médecine; Chirurgien de l'Hôpital Trousseau à Paris, et Député au Parlement Français, et Président de l'Association Générale de Médecine de France. 3 Rue François I., Paris.

1897. BENJAMIN LEE, M.D., Secretary of the State Board of Health of Pennsylvania. Crozer Building, 1420 Chestnut St., Philadelphia, Pa.

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1900. JAMES E. MOORE, M.D., Professor of Clinical Surgery and Orthopedic Surgery in the University of Minnesota; Orthopedic Surgeon to St. Mary's Hospital; Consulting Surgeon to the Northwestern Hospital for Women and Children; 802 Dayton Building, Minneapolis, Minn.

1893. LEOPOLD OLLIER, M.D., Professeur du Clinique Chirurgicale à la Faculté de Médecine de Lyon; Correspondant de l'Institut de France. 3 Quai de la Charité, Lyons.

1889. LEWIS A. SAYRE, M.D., Professor of Orthopedic Surgery in the Bellevue Hospital Medical College; Consulting Surgeon to the Bellevue Hospital, the Charity Hospital, and the Home for Incurables. 285 Fifth Avenue, New York.

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1894. Dr. JULIUS DOLLINGER, ausserordentlich-öffentlicher Professor für Orthopädie an den königl. ungarischen Universität in Buda-Pest, Operateur und dirigirenden Oberarzt der chir. Abtheilung im Spitalls der Barmherzigen Brüder in Buda-Pest; Mitglied des Landessanitätsrathes; Mitglied des Landesunterrichtsrathes; Mitglied mehrer wissenschaftlichen Gesellschaften und Vereine. Buda-Pest (Ungarn), Rerepescher Str. 52.

1890. Dr. A. HOFFA, Privatdozent der Chirurgie an der Universität Würzburg. Sieboldstrasse 10, Würzburg.

1890. ROBERT JONES, F.R.C.S. Edin., Honorary Surgeon, Royal Southern Hospital. 11 Nelson Street, Great George Square, Liverpool, England.

1899. C. B. KEETLEY, F.R.C.S. Eng., Senior Surgeon to the West London Hospital; Hon. Treasurer British Orthopedic Society. 56 Grosvenor Street, W., London, Eng.

1890. Dr. E. KIRMISSON, Professeur agrégé de la Faculté de Médecine; Chirurgien de l'Hôpital des Enfants Assisté. 27 Quai d'Orsay, Paris, France.

1890. Dr. SIGFRIED LEVY, Superintending Surgeon of the Society for the Relief of Crippled and Mutilated Children, Copenhagen. 135 Gothersgade, Copenhagen, Denmark.

ELECTED

1892. ERNEST MUIRHEAD LITTLE, F.R.C.S. Eng., Surgeon to the National Orthopedic Hospital. 40 Seymour Street, Portman Square, London, England.

1889. Dr. ADOLF LORENZ. IX. Garnisongasse 3 (Garellihoff), Vienna, Austria.

1889. HOWARD MARSH, F.R.C.S. Eng., Senior Assistant Surgeon and Lecturer on Surgery, St. Bartholomew's Hospital; Consulting Surgeon, Hospital for Sick Children, and Alexandra Hospital for Hip Disease. 30 Bruton Street, W., London, England.

1890. EDMUND OWEN, M.B., F.R.C.S., Surgeon to and Joint Lecturer on Surgery at St. Mary's Hospital; Senior Surgeon to the Hospital for Sick Children, Great Ormond Street. 64 Great Cumberland Place, W., London, England.

1892. PIETRO PANZERI, M.D., Direttore di Istitutio dei Rachitici, Milano. Via S. Calimero 31, Milano, Italy.

1892. ROBERT WILLIAM PARKER, M.R.C.S. Eng., Senior Surgeon, East London Hospital for Children; Surgeon, German Hospital, Dalston. 13 Welbeck Street, W., London, England.

1890. PAUL REDARD, M.D., Lauréat de l'Institut; Ancien Chef de Clinique Chirurgicale de la Faculté de Médecine de Paris; Chirurgien du Dispensaire Furtado-Heine. 3 Rue de Turin, Paris, France.

1888. BERNARD ROTH, F.R.C.S. Eng., Orthopedic Surgeon to the Royal Alexandra Children's Hospital, Brighton. 38 Harley Street, Cavendish Square, W., London, England.

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1899. OSCAR VULPIUS, Privatdozent der Chirurgie au der Universitat Heidelberg, Dozent für Orthopädische Chirurgie Dirigirender Arzt der Orthopädische Chirurgischen Heilaustalt in Heidelberg, Luisenstrasse No. 1.

ELECTED

1890. W. J. WALSHAM, F.R.C.S. Eng., M.B. and C.M. Aberdeen, Joint Surgeon and Lecturer on Surgery at St. Bartholomew's Hospital; Surgeon to Metropolitan Hospital; Consulting Surgeon to Hospital for Hip Diseases, Sevenoaks, and to the Bromley Cottage Hospital. 77 Harley Street, London, England.

1890. GEORGE ARTHUR WRIGHT, B.A., M.B. Oxon., F.R.C.S., Senior Assistant Surgeon, Royal Infirmary, Manchester; Surgeon to Children's Hospital, Pendlebury and Manchester. 8a St. John Street, Manchester, England.

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

ARTICLE I.—NAME.

THIS Society shall be called the "AMERICAN ORTHOPEDIC ASSOCIATION."

ARTICLE II.—OBJECT.

The purpose of this Association shall be the advancement of orthopedic science and art.

ARTICLE III.—MEMBERSHIP.

SECTION 1. The members shall be graduates of regular medical schools, shall be in good professional standing, and shall be especially interested in Orthopedic Surgery.

SEC. 2. There shall be three classes of members, viz.: Acting, Corresponding, and Honorary.

SEC. 3. The number of Active Members shall be limited to sixty, and of Corresponding Members to thirty.

SEC. 4. Candidates for membership shall have been engaged in the practice of medicine for at least five years, and shall have given evidence of satisfactory scientific attainments.

ARTICLE IV.—OFFICERS.

The officers shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary, and a Treasurer, all to be elected annually at the last executive session of a regular meeting.

ARTICLE V.—STANDING COMMITTEES.

There shall be a Committee on Membership, consisting of five members, a Committee on Publication, consisting of three members, and an Executive Committee, consisting of the President, the Secretary, and the Treasurer.

ARTICLE VI.—ELECTIONS.

All elections shall be by ballot; for officers a majority shall elect, for members a four-fifths majority.

ARTICLE VII.—MEETINGS.

The meetings of the Association shall be Regular and Special.

ARTICLE VIII.—FEES.

Active members shall pay an initiation fee of twenty-five dollars, and annual dues of fifteen dollars.

ARTICLE IX.—PUBLISHED PROCEEDINGS.

The business proceedings of the Association shall be published annually. The papers and discussions shall be published annually, unless the Association otherwise directs at the close of the regular meeting.

ARTICLE X.—DISCIPLINE.

A three-fourths vote of all members present at a regular meeting shall be necessary for suspension or expulsion of a member.

ARTICLE XI.—THE CONGRESS.

SECTION 1. This Association shall hold membership in and meet with the Congress of American Physicians and Surgeons.

SEC. 2. It shall, at the first annual meeting held after the adjournment of any Congress, elect a member to represent it on the Executive Committee of the Congress for the ensuing three years, and it shall also elect a second member as an alternate.

ARTICLE XII.—QUORUM.

An actual presence of nine active members at any one meeting shall be necessary for the transaction of business.

ARTICLE XIII.—AMENDMENTS.

Alterations to this Constitution may be made at any regular meeting by a four-fifths vote of all the members present; provided that notice

of the proposed changes, signed by two active members, shall have been given to all the active members at least one month previous to final action.

BY-LAWS.

ARTICLE I.—MEMBERSHIP.

SECTION 1. Nominations for membership shall be made in writing, signed by the proposer and seconder, accompanied by evidence as to the fitness of the candidate for fellowship, and shall be placed in the hands of the Secretary at the previous meeting to the time of the regular meeting.

SEC. 2. Candidates for active membership shall, through the Secretary, present a paper to the Association.

SEC. 3. Only those of acknowledged pre-eminence in orthopedic surgery shall be eligible to honorary membership.

SEC. 4. Foreign residents only shall be eligible to corresponding membership.

SEC. 5. All the scientific privileges of the Association shall be accorded to the honorary and corresponding members.

SEC. 6. Membership shall be forfeited when one ceases to take an active interest in the objects of the Association, or is guilty of an unprofessional act or a public misdemeanor. Action in such cases shall be taken according to Article X. of the Constitution.

SEC. 7. An active member absenting himself for three consecutive meetings, or two years in arrears in payment of dues, may be dropped from the rolls.

SEC. 8. All members in attendance at any meeting shall register in a book provided for the purpose.

ARTICLE II.—OFFICERS AND STANDING COMMITTEES.

SECTION 1. The duties of officers and standing committees shall commence after the adjournment of the meeting at which they are elected or appointed, and shall continue until their successors are duly installed.

SEC. 2. The President shall preside at all meetings, shall deliver an annual address, shall appoint a Committee on Membership of five, two of whom shall have served the preceding year, and a Committee on Publication, and shall fill any vacancies that may occur from resignation or otherwise. The names of the members of the committees thus appointed by the President shall be printed in the annual minutes.

Sec. 3. The Vice-President shall act in the absence of the President.

Sec. 4. The Secretary shall give due notice of and keep the minutes of all meetings, shall conduct all correspondence, shall notify candidates of their election to membership, shall send all papers pertaining to candidates for membership to the chairman of the Committee on Membership one month previous to the time of the annual meeting, including their theses, and inform members of their appointment on committees, and shall perform such other duties as are assigned to him by the Association.

Sec. 5. The Treasurer shall collect all moneys due the Association, be the custodian of the same, and pay it out only on warrant signed by the President and Secretary. At the annual meeting he shall make a report of his receipts and expenditures, which, after being duly audited, shall be filed.

Sec. 6. The Membership Committee shall consider the eligibility of all nominees for membership, and shall report its recommendations to the Association.

Sec. 7. The Executive Committee shall make all necessary arrangements for the meetings of the Association, assign the order for scientific work, and report the same to all members as early as practicable before the time of the annual meeting. It shall further manage such necessary affairs of the Association as are not already assigned to others.

Sec. 8. The Publication Committee shall attend to the preparation, publication, and distribution of the annual proceedings of the Association; and shall have discretionary power as to the matter for publication in questionable cases.

ARTICLE III.—ELECTIONS.

The election of officers and members shall be held at the last executive session of the regular meeting.

ARTICLE IV.—MEETINGS.

Section 1. The regular meetings shall be held annually during the third week in May of each year, or at such other time and at such place as the Association may elect. If no action should be taken in the matter, the Executive Committee shall decide.

Sec. 2. Special meetings may be called by the Executive Committee or by the President at the written request of ten active members.

Sec. 3. Every third year the Association shall convene as a part of the Congress of American Physicians and Surgeons.

ARTICLE V.—DUES.

The yearly dues shall be paid to the Treasurer at the time of registration.

ARTICLE VI.—PUBLISHED PROCEEDINGS.

SECTION 1. The Transactions shall be printed as soon after the adjournment of the regular meeting as possible, and distributed to the members, one copy to each, except to those in arrears on Association dues.

SEC. 2. Additional copies of the Transactions shall be furnished to members at cost, and to the public at a price to be determined by the Publication Committee.

SEC. 3. Authors desiring reprints of their papers will notify the Publication Committee, who shall already have established rates for reprints with the publishers.

SEC. 4. Papers not in the hands of the Secretary within four weeks after adjournment of the meeting shall be omitted from the Transactions on the unanimous vote of the Publication Committee.

ARTICLE VII.—PAPERS AND DISCUSSIONS.

SECTION 1. Papers read before the Association shall be limited to twenty minutes, unless the time be extended by vote. Discussions shall be limited to five-minute speeches. No member shall speak a second time on the same subject if others desire the floor. The author of the paper shall be privileged to close the debate.

SEC. 2. No papers shall be read that have been previously published. Members publishing their papers after they have been presented to the Association shall designate them, "Read before the American Orthopedic Association." Authors desiring their papers illustrated shall furnish the necessary wood-cuts.

SEC. 3. Proofs sent to authors should be returned within a fortnight, otherwise the matter will go to press without the author's corrections. Marked changes from copy, known as "time-work," shall be paid for by the author.

SEC. 4. Transcripts of the discussion shall be furnished the participants for correction, but not for rewriting.

ARTICLE VIII.—EXECUTIVE.

SECTION 1. Two executive sessions shall be held during each regular annual meeting—to wit: at noon of the first day and at noon of the last day. The order of business shall be:

1. Reading of unapproved minutes and records.
2. Reports of officers and committees and action thereon.
3. Unfinished business.
4. Election.
5. New business.

The last act before the adjournment of the last session shall be the reading of unapproved minutes and action thereon. Urgent business may be transacted at any session by unanimous consent.

SEC. 2. The proceedings of the Association shall be in accordance with parliamentary usage.

ARTICLE IX.—AMENDMENTS.

All proposed amendments to the By-laws shall be submitted in writing, signed by two active members, at a previous annual meeting. A three-fourths affirmative vote of all members present at a regular meeting shall be necessary to ratification.

THE PRESIDENT'S ADDRESS.

By HARRY M. SHERMAN, M.D.,
SAN FRANCISCO.

I HAVE for presentation to you at this time some inferences which are drawn from rather imperfect data, I fear; but it did not prove possible to get, on the subject of this paper, data much more accurate, and so I have used them as they were presented to me. I wished to see if any plain mark could be found outside of the Association which would show the influence of the Association on orthopedic thought or orthopedic education and study, a mark that would be obvious evidence that the Association was doing something more than train to higher degrees of proficiency the specialists and general surgeons who make up the membership, a mark that would indicate that the Orthopedic Association was concerned, more or less intimately, with the development of orthopedic science and art which certainly has taken place in the last decade in the United States. To have answered this question completely would have required a knowledge of the personal histories of all the men engaged in teaching or in practising, exclusively or chiefly, orthopedic surgery; at least it would have required a record of their medical studies, including the names of the schools and of the teachers in which and with whom they had studied. The gathering and classifying of this mass of statistics would have been a task which my time forbade me to attempt, and it seemed more feasible and easier of accomplishment to get the record of schools instead of that of individual teachers or practitioners. Postal cards were, therefore, addressed to all the colleges of medicine that were members of the Association of American Medical Colleges, merely asking for their catalogues, announcements, or circulars. There are seventy-six of these, and answers were received from all, and from not a few came also personal letters solicit-

ing my attendance as a student, for my postals did not disclose the fact that I was already a graduate in medicine.

Of the seventy-six colleges only thirty-eight mentioned orthopedic surgery as being taught, either by a professor or a lecturer, either didactically or clinically. This is not a particularly good showing; in fact, it is particularly bad, for it shows that only half of the representative medical schools of the United States consider orthopedic surgery of sufficient importance to even cursorily mention the teaching of it. In a certain way this is also something more than mere oversight, for of these same schools, sixty, that is about 79 per cent., specialize gynecology; fifty-nine, that is about 77 per cent., specialize pediatrics, and fifty-eight, that is about 76 per cent., specialize neurology, while the only recognized specialty which has a lower percentage of representation in these schools than orthopedic surgery is genito-urinary surgery, which is taught in only thirty-seven, or about 49 per cent.

The statistics regarding ophthalmology, otology, rhinology, and laryngology were not taken from the catalogues. These are such old established lines of special work that it was assumed that they would be represented by special teachers on the faculties of all the schools.

The high percentage of representation which gynecology has is not surprising, for the gynecologist was the pioneer in abdominal surgery, and that particular region is to-day the most attractive field for surgical work, both because of the undoubted interest of its problems, solved and unsolved, and also because of the larger monetary reward that it secures. That pediatrics should have so high a percentage, comparatively, of representation is surprising, for, as a modern specialty, it is not old, and the American Pediatric Society was founded in 1888, one year after our own organization. However, pediatrics deals chiefly with acute conditions, the fatiguing element of chronicity is not inherent in a larger part of its practice, and this may be taken as part explanation of its more readily securing special practitioners. As another factor of the explanation the antitoxin treatment of diphtheria may be counted, a treatment that could not fail to develop a body of special workers who naturally became pediatrists; in fact, I have read papers on this subject written by men who announced themselves as specialists

for the treatment of this disease, thus making a specialty within a specialty. Finally, it must not be overlooked that the activity of the American Pediatric Society may easily have influenced many to study particularly and to practice wholly or chiefly pediatrics, a specialty that requires comparatively little specialized skill, but rather the specialized application of well-understood general principles, and that is easily made his own by the accoucheur and the general practitioner.

Neurology, however, is nearly as popular a specialty as pediatrics, and yet it rivals orthopedic surgery in the chronicity of many of the conditions it treats, and is much more limited in its opportunities for treatment which may be radical or successful; in fact, oftentimes its practitioner is limited to scientific watchfulness over his patient and the course of his ailment. It seems to me to be the specialty *par excellence* for the student, the contemplative man, who is happy in watching the evolution of a natural process, or who takes particular pleasure in unravelling the unquestionably difficult problems it presents. Certainly the neurologist who can say to the surgeon: "Open this head at that place and you will find a tumor," and who can oversee the work and find his prediction true, has a very satisfactory measure of reward for his labor; and I have thought that in some instances the satisfaction at the demonstration of diagnostic accuracy was almost as great if the evidence was procured on the necropsy table.

Genito-urinary surgery, taught as a special branch of surgery in only 49 per cent. of these schools, saves orthopedic surgery from being the lowest in the list. It cannot be because of lack of material that this is so, nor because the sufferer is indifferent concerning his condition and not solicitous about his recovery. It must be because the general surgeon still considers that genito-urinary surgery is his own, just as, in many instances, he thinks that orthopedic surgery is his own, and he continues to practice each specialty as a part of general practice. I am sure that the verdict of the public is a true one, and that the demand for a specialist, even in these two branches, is a just one, for the general surgeon too often in orthopedic cases lets his instrument-maker indicate the line of treatment by suggesting and making a brace, or shows himself to lack full appreciation of the mechanical ideas underlying brace-work. Probably the specialist in genito-urinary surgery would have parallel criticisms to make.

To the thirty-eight colleges which announced in their catalogues instruction in orthopedic surgery, circular letters were addressed asking the date at which instruction had been first begun, but only twenty-eight answered my question. Of this twenty-eight only six had included the subject in the instruction given before 1887, the year of the founding of this Association. These were the Bellevue Hospital Medical College, where our Doctor Sayre gave his well-known lectures; the Detroit College of Medicine, which began special orthopedic instruction in 1875; the St. Louis College of Physicians and Surgeons, which began special instructionat the opening of the school in 1879; the College of Physicians and Surgeons, University of Illinois, which established a separate chair in orthopedic surgery in 1883; the Western Pennsylvania Medical College, which has taught it by a special teacher for a period of sixteen years; and possibly the Iowa College of Physicians and Surgeons, in which the first course of lectures on medicine was delivered in 1883 or 1884, regular instruction by a special teacher in orthopedic surgery following two or three years later. Rush Medical College had a professor of orthopedic surgery about sixteen years ago, but the chair has been vacant for some years, and the same is true of the Medical Department of the University of California. It seems incredible that this meagre list should include all the places where the subject was specially taught prior to 1887, but yet the list is accurate so far as the replies to my inquiry are concerned; and in view of the scant attention paid to our subject such a short while ago one can easily imagine the gap which the post-graduate schools came to fill.

Since 1887 nineteen colleges, according to the replies I received, have inaugurated the teaching of orthopedic surgery, or have been founded and included chairs on this subject in the original faculty. In 1888 the University of Minnesota was founded, and taught the subject from the beginning. In 1889 Harvard inaugurated its teaching in its Medical Department, and Jefferson Medical College appointed a clinical lecturer. In 1890 the Woman's Medical College of Pennsylvania appointed a clinical professor of orthopedics, and the University of Buffalo is said to have taught it at the same time. The Cleveland College of Physicians and Surgeons reports that orthopedic surgery was first taught in 1890, and the chair has remained ever since. In 1891 the Omaha Medical College estab-

lished a special chair in orthopedic surgery. In 1892 the Barnes Medical College was established, and taught orthopedic surgery from its beginning, and in 1893 the Wisconsin College of Physicians and Surgeons and the Jenner Medical College came into existence, and also taught it from their beginnings. In 1894 the Yale Medical School appointed a special lecturer, and the Medical Department of the Columbian University inaugurated a special course in orthopedic surgery. In 1895 the Kansas Medical College began teaching the subject, and the College of Physicians and Surgeons in New York appointed a clinical professor of orthopedic surgery. In 1896 the Rush Medical College and the Medical Department of the University of California resumed the teaching of orthopedic surgery, the Creighton Medical College established a chair and Tuft's College Medical School appointed a special instructor. In 1897 the Medico-Chirurgical College of Philadelphia appointed a professor of orthopedic surgery, and the Illinois Medical College did the same. In 1898 the Milwaukee Medical College established didactic teaching by a special teacher.

Of the twenty-eight replies three were so ambiguous as to be useless in this particular, and it must be acknowledged that the dates here given may not be, in each instance, correct, for many of the replies mentioned only an approximate time as that at which this instruction had been begun, and did not give a definite date. But, while there may be slight inaccuracies, the statement in general is true, that all of the principal medical schools of the country which did not teach orthopedic surgery prior to 1887 have since begun to do so, and that all of the schools which have been organized since 1887 have included a teacher of orthopedic surgery in the original faculty. As a broad inference from the few figures here collected it may be stated that since the organization of our Association in 1887 the number of teachers of orthopedic surgery in this country has been more than quadrupled.

To bring this a little closer to our Association, it is necessary to see what representation we have in this body of teachers, and it is plain that it is a very good one, for of our fifty-one active members twenty-six are engaged in teaching orthopedic surgery in the following twenty-three medical schools: Harvard University Medical School, Rush Medical College, College of Physicians and Surgeons

in New York, Minnesota State University, Chicago College of Physicians and Surgeons, Missouri Medical College, Woman's Medical College in New York, University of Minnesota, Denver University, Tuft's Medical School, University of the City of New York, Northwestern University, University and Bellevue Hospital Medical School, Medical Department Columbian University, Medical Department University of California, Medical Department Washington University, Woman's Medical College in Baltimore, Baltimore Medical College, Medical Department of University of Niagara, University of Pennsylvania, Jefferson Medical College, Medical Department University of Wooster, Woman's Medical College in Philadelphia. This list takes no account of post-graduate instruction.

Taking thirty-eight as the approximate number of medical schools in the country, which, according to their announcements, teach orthopedic surgery, we have representation in 60 per cent. of them; and taking into consideration the type of medical school which the majority of the schools in the country represent, and the complex qualifications which we require of a candidate for election, it would seem that the Association should be content with this, and neither seek to get its members into other and newer schools, nor to hold out inviting hands to all the teachers of orthopedic surgery in the new schools who are not already of our membership. With this representation we cannot fail to influence the thought of the day in orthopedic surgery; it is not possible that, with 60 per cent. of the teaching of orthopedic surgery in our hands, there should not be a steady increase in the amount of correct orthopedic principles known and practices applied by the general practitioner, and an occasional evolution, out of the general mass of physicians and surgeons, of an orthopedic surgeon who will be a new pioneer and will carry the art to a still higher point of development.

Turning again to the catalogues and announcements of the schools that claim to teach orthopedic surgery, we find that there are twelve that content themselves with the bald statement of this fact, and say nothing of the methods of instruction employed nor of the time devoted to it, and this omission must detract from the value of the general announcement of instruction, for the work is very probably not systematic nor in any way a prerequisite for graduation. These

are: St. Louis College of Physicians and Surgeons, Milwaukee Medical College, Columbian University, Rush Medical College, Jefferson Medical College, Kansas Medical College, Medical College of Indiana, Sioux City College of Medicine, Louisville Medical College, Baltimore University, Western Reserve University Medical College, and Hamline University.

Nine schools limit the teaching to didactic lectures, eight giving one hour a week during the term, and these are: Iowa College of Physicians and Surgeons, University of Illinois College of Physicians and Surgeons, Jenner Medical College, Creighton Medical College, University of Omaha, Marion-Sims College of Medicine, Albany Medical College, and the Illinois Medical College, while the Cleveland College of Physicians and Surgeons gives one-half hour a week during the term.

In thirteen the instruction is entirely clinical. Of these, five—the Detroit College of Medicine, Western Pennsylvania Medical College, University of California, University of Denver, and University of Buffalo give one hour a week. Three, the Medico-Chirurgical College, Tuft's Medical College, and Barnes Medical College give two hours a week. One, the Northwestern University Medical School gives one hour a week throughout the term, and three hours extra a part of the time. One, the College of Physicians and Surgeons in New York, gives one hour a week throughout the term, with twelve hours' section instruction in addition for each student in the fourth year. One, the Cornell University Medical College, gives one clinical lecture per week, and with two hours' section demonstration per week for two months. Two, the Woman's Medical College of Pennsylvania and Ohio Medical University, do not mention the time. Five schools announce both didactic and clinical instruction; Harvard, one hour didactic and two hours clinical per week; Yale, didactic and clinical, one hour per week, presumably for both; University of Minnesota, two hours didactic and one hour clinical per week; Woman's Medical School of Northwestern University, one hour per week, divided between clinical and didactic; the Grand Rapids Medical College, but this institution, while making the broad announcement of clinical and didactic instruction, makes the unhappy mistake of neglecting to state the time assigned to these.

There is an opportunity here for considerable criticism, and it can

be directed without reservation against those institutions which teach orthopedic surgery by didactic lectures alone. One might as well try to make an artist, or a sculptor, or a musician by didactic instruction. Orthopedic surgery uses, to an enormous degree, the hands of its practitioners. The technique of the application of dressings and braces to develop corrective or restraining force requires manual skill as well as scientific knowledge, and the art cannot be known except by practice. It is a satisfaction to note that this Association is not interested in any of these schools.

In the schools where the instruction is wholly clinical a much better method is, in general, observed, but from the information in the catalogues I cannot learn how much the instruction individualizes the student. To watch an expert at work is immeasurably superior to hearing his methods described, but there is a great degree of difference between merely looking on and trying to educate your own fingers. It is this finger-and-hand education that the student needs, and clinical methods which do not give him an opportunity for personal acquaintance with plasters, webbings, buckles, braces, and the plaster-of-Paris bandage, and, more important still, the ability to handle the limbs of children without hurting them, the knack of moving his own body to change his position without moving his hand, which must keep the child's limb immobile—the clinical method which does not, I say, accomplish some or all of this must, in a large measure, fail of its object.

The plan of instruction which uses both didactic and clinical methods I consider the best. There are certain special principles underlying correct orthopedic practice which a teacher of general surgery is most apt to slur or omit, and the teacher of orthopedics has a definite duty in elaborating them in lectures devoted to that purpose, so that the student may understand fully their scope and their limitations: they cannot be given adequate attention on particular cases at the bedside and in the out-door clinic. Again, while it is true that, with the improvements in the methods of teaching pathology, the need for lectures on what is called "surgical pathology" is lessening, still the teacher of surgery constantly refers to pathology to make a special application to the condition under discussion, and so the teacher of orthopedic surgery must discuss, for one thing, tuberculous conditions in bone, not to teach the pathology

of tuberculosis, but to make a special application of the general principles the student has learned in the pathological laboratory, and this can best be done, I think, in didactic lectures in which the pathological and clinical conditions shall be brought into the relation of cause and effect, and the whole be so graphically described that they shall make what might be called a composite photograph on the student's mind, so that where he sees one he must of necessity think of the other. With the didactic instruction there should be associated individual training in the clinic. The clinic should be a manual training school in which the eye and hand should be taught to perfectly co-operate to the production of the best finished product.

I know perfectly well the difficulty in finding, in the time allotted to the study of medicine, the hours which may be devoted to this; if the subject is not specialized and the assignment of time is left to the faculty at large the time will not be given. But in all schools where orthopedic surgery is specialized its teachers must stand for proper recognition and demand and secure ample time. One hour a week is too little, two hours a week, or about one hundred and twenty hours a year, is none too much, and of these, one hundred hours should be spent in the clinic, and not more than twenty hours in didactic work.

I do not need, before this Association, to plead for the teaching of orthopedic art, but I cannot help referring to one view of the matter which is too often overlooked. It is not as a sentimentalist that I mention the child's age and his helplessness. It is because the acts committed on him when he is helpless and young reach out and affect him when he is neither. The old can get, at best, but a few years of benefit from any surgical procedure, and no matter how grateful that benefit may be, its enjoyment in time is limited. The middle aged may have only the last half of life made or marred by surgery. But the child has to be contented or discontented for all his life with the result of the orthopedist's work, and the physical conditions, especially in regard to deformities, affects so much the mental state that the physical success or failure, in even a minor matter, may easily tell for good or evil in the final development of a mind and the shaping of a character. I am sure that in keeping a spine straight, in securing a satisfactory functional result after a joint tuberculosis, in properly correcting a malformed foot or a twisted

limb, is doing infinitely more than mechanical work on living tissues. In restoring an individual to physical likeness to his fellows we are possibly returning his to unison and harmony with all the good thoughts and acts of men, instead of leaving him, in his own mind, specialized, individualized, and even stigmatized by some marring deformity. We have all of us met this man, we have heard his bitter denunciation of those who were responsible, as he thought, for his condition; and while usually his judgment is as twisted as his body and is wholly unjust, the bitterness of his words is unmistakable. Let us look to it that all the knowledge we possess may be so made use of that an ever-widening field for its helpful practice may be assured.

It becomes my duty to chronicle the deaths in the past year of two of our Active Members.

Samuel Ketch died on December 14, 1899, of angina pectoris.

Dr. Ketch was born on July 5, 1855, on Bleecker Street, in New York, that being then a favorite residential part of the city. His education was in the public schools and in the College of the City of New York, and from the latter he took an undergraduate's certificate and entered Bellevue Hospital Medical College, graduating in medicine in 1875. It is said of him, and we who knew him can easily understand it, that he was a good student and scholar, and won the liking of his teachers. Very early in his professional life he became identified with orthopedic surgery by his appointment at the New York Orthopedic Dispensary and Hospital, and he retained his relation to that institution until his death, being at that time Attending Surgeon. He was also Attending Orthopedic Surgeon to the Montefiore Home and Hospital for Chronic Invalids, and was Clinical Professor of Orthopedic Surgery in the Woman's Medical College of the New York Infirmary for Women and Children. In this Association he was one of the original members. Outside of his work in this Association, of which the *Transactions* give a record, his most notable papers were on the "Occurrence of Scoliosis in Young Girls," and his article on "Clubfoot," in the *Reference Hand-book of the Medical Sciences*, in which he collaborated with the late Sydney Roberts, of Philadelphia.

Personally, it can be said of him that one does not often meet a

man who has a more even disposition than had Dr. Ketch, or who can be counted on with more certainty to do what seems to him to be right than could Dr. Ketch. I never saw him anything but courteous, and I know that his conduct was often directed by a generosity which was sometimes almost a fault. It cannot fail to be the verdict of the Association that in his death a valued and valuable member has been lost by us. It must be mentioned, too, that at the last meeting of this Association in Washington, in 1897, Dr. Ketch was the presiding officer. Dr. Ketch was never married.

Albert Edward Hoadley died January 16, 1900, of cardiac degeneration, after a very brief illness.

Dr. Hoadley was born in Shenango Forks, New York, in 1847, and was taken by his parents to Illinois when he was about five years old. He graduated in medicine from the Chicago Medical College in 1872, and at once entered on the practice of his profession. In 1882, when the College of Physicians and Surgeons, now the Medical Department of the Illinois State University, was started, he was made Professor of Anatomy. He taught anatomy until 1888, when he was made Professor of Orthopedic and Clinical Surgery, and that year he spent abroad, studying pathology and surgery. In 1890 he assumed also the Professorship of Orthopedic Surgery in the Chicago Polyclinic, and continued in active duty in both institutions until his death.

Dr. Hoadley was a man of very definite ideas, and, until recent years, when he became more conservative, he was markedly progressive. His strong points were his knowledge of anatomy and a mechanical talent, the latter being very strongly developed, although he had no technical training in mechanics. It is probable that that clear conception of a thing in all its parts, which is necessary for a mind that understands mechanical matters, was an underlying factor in his success in teaching orthopedic and general surgery, for in this work he was eminently practical, his methods being terse, but very clear.

Dr. Hoadley was an ex-President of the Chicago Medical Society and a member of many other medical societies. He became a member of this Association in 1892.

He was twice married, but had no children, and his second wife survives him.

I wish to make, in closing, one suggestion. It is the duty of the President to prepare the programme, and he has, very naturally, an interest in its presentation and afterward in its publication. It would seem not unwise, therefore, that the President of any one year should be, *ex-officio*, a member of the Publication Committee which published the *Transactions* of the meeting which he arranged and over which he presided. I am sure that we cannot improve on the *personnel* of the present Publication Committee, but the addition of another member who might have a very keen interest in the matter, and might be a good working member, from reasons a little selfish, might not be a detriment. A change of this sort would require a change in the Constitution, and I beg to offer the suggestion that such a change be made. This would preserve the present committee intact, and would result in the addition, each year, of one new man, whose services would be for that year only.

THE TREATMENT OF ABSCESSES OF THE JOINTS WITH GLASS SPECULUM, DRAINAGE AND PURE CARBOLIC ACID, WITH A REPORT OF SEVENTY CASES.

By A. M. PHELPS, M.D.,
NEW YORK.

Last year I had the honor of presenting to this Society a plan of treating abscesses and diseases of the joints by a method somewhat unique. I also presented at that meeting a report of several cases of erysipelas treated in the City Hospital with pure carbolic acid, and the charts of those cases showed that the plan of treatment aborted every case.

Since the reading of that paper I have operated on all suppurating and tubercular joints with abscesses by the plan presented at that meeting. All of our erysipelas cases at the City Hospital have been treated with applications of pure carbolic acid, and during the past year, of the scores of cases so treated in the erysipelas pavilion and surgical wards, all have been either aborted or immediately arrested, and I believe no deaths are recorded.

In regard to the use of pure carbolic acid in tubercular and suppurating joints, and the method of its application, I am thoroughly committed to, and I urge upon the profession the importance of following the method, because I am convinced that it is superior to any other that I have resorted to or of which I know. There is a wide difference of opinion in the orthopedic profession as to the advisability of operating upon these joint abscesses. We have one extreme wing who advocate the do-nothing plan, and in one of Ridlon's papers, he states that not one case in a hundred should be interfered with. Then we have another wing of the profession who believe that abscesses which are causing constitutional or any considerable local disturbance should be operated upon. Lastly,

another portion, to which I belong, believe that every suppurating or tubercular process of joints attended with abscess should be operated upon as soon as a diagnosis is made, and for the following reasons:

Abscess in no way interprets the pathological condition present in a joint. The largest abscesses, those which cause the greatest constitutional disturbance, are attended frequently with a small amount of or no bone disease, whereas the more severe forms of bone diseases of joints are frequently attended with small abscesses which cause no constitutional disturbances, but which insidiously destroy the entire joint, resulting later on, if early interference is not insisted on, in a complete excision or the death of the patient.

Knowing these facts as I have observed them in hundreds of cases clinically, I urge an early operation as soon as a diagnosis is arrived at on all abscesses, either tubercular or purulent. The operation is performed for two purposes:

First, and the most important, for the purpose of exploring the joint to ascertain the parts involved and the amount of destructive changes which have taken place.

Second, for the purpose of thorough drainage. An empty house is better than a bad tenant, and, surely, if living tissue lies in contact with tubercular or purulent material, infection necessarily takes place with destruction of bone or soft parts in proportion to the duration of maceration and extent of infection.

And then, again, abscesses, particularly of the hip-joint, in a very large proportion of cases, ulcerate through the capsule anteriorly, rupturing into the iliacus internus muscle, a portion of which rises from the anterior border of the capsule, thereby finding its way by burrowing upward over the brim of the pelvis into the iliac fossa. Such cases nearly always result in extensive destruction of the inside of the ilium, because drainage from this fossa is interfered with on account of the pressure of the tissues lying across the brim of the pelvis. After years or months have elapsed, on account of the condition of the patient, an operation is deemed advisable, and the surgeon will frequently find that he has to detach from the crest of the ilium the abdominal parietes, and with a scoop and chisel remove the entire iliac fossa. This accident could be easily avoided by early exploratory operation as early as fluctuation is detected about the joint.

And then, again, if the abscess does not find its way into the iliac fossa, Scarpa's triangle becomes filled with pus, burrowing takes place frequently through the triangle, making its appearance on the posterior aspect of the leg, or underneath the fascias downward upon the anterior aspect of the thigh, destroying whole groups of muscles.

There is no reason that I can find for allowing any abscesses to produce these secondary destructive changes. Very frequently—and I have a list of several cases—perforation of the acetabulum takes place. Pus finds its way down along the inside of the pelvis between the bone and the pelvic fasciæ by the side of the rectum, rupturing into it, and often destroying the sphincter muscles or establishing a communication between the joint and the rectum, from which fecal matter and gas constantly escape.

Such cases I have operated upon, and they are most serious and difficult to remedy. An early operation would have prevented this calamity. Pus never finds its way into the iliac fossa or the retroperitoneal cavity through the acetabulum, so that it can be felt by palpation from above. This has been taught, but it is a mistaken idea, and the gentleman who first wrote it, and those who afterward copied it in their writings, had had no clinical observation upon the subject, or the error would never have crept into our literature. The only way that pus ever finds its way into the iliac fossa is by the route which I have already described, on account of the rupture of the capsules anteriorly.

Now let us go back a little, and examine briefly the etiology and pathology of the conditions which lead to abscess. My remarks will be confined to hip-joint disease alone. Hip-joint disease, either tubercular or purulent, is always preceded by lesion either of the bone or the soft part. There must necessarily be, according to the laws of bacteriology, a soil fit for the reception and growth of bacteria. This soil is inflammatory new material. When a lesion has occurred, from injury or from embolism, there is at once an effort of nature made to repair. If inoculation into this area of normal inflammatory material does not take place, such a child will have all the symptoms of hip-joint disease, and will recover within a month or two, unless subsequent injuries are inflicted.

These are the cases of so-called ephemeral hip-joint disease. They

are simply cases of normal inflammatory action for the purpose of repair. This normal inflammatory action is attended by the following conditions:

When a lesion has been produced, hemorrhage takes place; then the wandering of cells, or rapid cell proliferation at the point of lesion. The bloody clot becomes organized by displacement. Cells arrange themselves into line to repair the tissues injured. Loops of capillaries and small nerve filaments are thrown out into this new inflammatory material for the purposes of nutrition. After a little, each cell becomes converted into tissue resembling the tissue which has been injured—bone-cells producing bone, other cells producing soft parts. After a time, organization has taken place, contraction of the new inflammatory material takes place. The loops of the capillaries and nerve filaments are destroyed by pressure, and a scar is left.

If the pathogenic bacteria are floating in the circulation of the child, and they come in contact with this new inflammatory material during the normal process of repair, inoculation is likely to take place, and cell after cell in this new inflammatory material becomes destroyed, and bacteria deposit or secrete their toxins, and the entire area of inflammatory repair is converted into a pus or tubercular cavity. This pus cavity, filled as it is with bacteria, is a reservoir from which infection to surrounding tissues takes place. If the diseased cavity is in the head of the bone or neck, it enlarges until perforation occurs and the joint itself becomes secondarily infected. If the infection is in the epiphyseal lines of the acetabulum, then the joint becomes secondarily infected at the same time as the primary infection in the acetabulum. The head of the bone and acetabulum may become secondarily infected from the abscess within the capsule of the joint, when soft parts are primarily involved. In other words, the maceration of these bony structures in this infectious material loaded with bacteria and virulent toxins results in secondarily involvement and destruction of the entire bony structure of the joint.

Understanding these propositions, which in the surgical world are accepted, and surgical bacteriology, pathology, and clinical observations have demonstrated them—I cannot see how it is possible to accept the non-interference plan with these active and destructive pathological processes as a rule of practice.

It is a fact that perhaps one abscess in ten, either of joints or other tissue of the body, may be absorbed. It is also a fact that more than 50 per cent. of abscesses of joints will find their way to the surface in such a manner as to establish good drainage, and thereby allow the joint to recover under proper mechanical treatment. But what are we to do with the other 50 per cent. of cases that produce dangerous disturbances? How are we to distinguish the benign from the malignant? Without an exploration we cannot. The rule followed in cases of appendicitis should be followed in abscesses of joints, and precisely the same surgical principles should be adopted in abscesses of joints as in abscesses of any other part of the body, more particularly of the shaft of long bones. No surgeon of any reputation would ever think of trusting a case of osteomyelitis or tubercular abscesses of the bone to nature. Such conditions are always operated upon, and life and limb saved that otherwise would have been sacrificed. In cases of appendicitis, no surgeon to-day would think of trusting such cases to nature. An abscess of the appendix ruptures into the abdominal cavity, when not surgically treated, in 75 per cent. Of all cases there is a mortality of over 35 per cent., whereas, from early surgical interference, the mortality is a fraction of 1 per cent. These same arguments can be applied to abscesses of the joints. If every joint which is suppurating, whether tubercular or purulent, is operated upon, the mortality and destruction of that joint will be reduced to a very small percentage, whereas, if not operated upon, the mortality ranges from 8 to 12 per cent.; and excisions or chronic sinuses lasting for years or for life will be found in a very large percentage of such cases, but just what percentage I am unable to state. I know that in my clinics at the Post-Graduate, which are made up largely of cases from other clinics and hospitals, more than 75 per cent. are chronic diseases of the joints, with abscesses involving the bones of the joint, and frequently of the pelvis, which have existed for years. Now, if such cases had been early examined and evacuated, the excisions which I am now obliged to perform could be avoided. The mortality from excisions of the hip-joints probably ranges as high as 3 or 4 per cent.

Certainly, then, such cases, if early operated upon, would be unattended with this mortality. Secondly, excision of the hip shortens the limb from two to two and a half inches. Now, if all joints with

abscesses were early operated upon, as soon as a diagnosis is made, in my opinion excisions would not be necessary one time in a hundred; whereas, if such abscess cases are not operated upon, excisions will result, or should be performed in more than 25 per cent. of the cases.

Statistics from the Fifty-ninth Street institution in New York show that abscesses occur in over 60 per cent. of the cases there treated. The same is true of the Forty second Street Hospital. From the Children's Hospital in Boston, 35 per cent. Now of these abscess cases—given a hundred—nature will open and take care of probably 50 per cent., and satisfactory results will be obtained by mechanical treatment. Of the other 50 per cent., on account of the favorable opening of the abscess, which permits of drainage, and under careful mechanical treatment, results will be obtained with shortened limbs from one-half inch to two inches, with extreme atrophy, from which the patient never recovers. These results will be obtained after years of mechanical treatment. Now the other 25 per cent. will find their way into the various hospitals and dispensaries of the city, where they will be found to be suffering from diseases of the liver and kidney, with extensive bone destruction, with dislocations of the hip, with shrivelled and atrophied limbs, with great deformity, necessitating excision in nearly every case.

This is what I have observed during fifteen years of dispensary life in New York City, and we might as well look the facts in the face now as at any time.

The fifty cases which would have recovered could not possibly have received any injury by the incision and careful drainage, because the antiseptic finger and the clean knife blade could not possibly do the infected and suppurating joints any harm. No expert diagnostician could possibly determine which abscesses would take a favorable course and which might kill. The only possible chance of constitutional consequences would be through the denuded surface which was made by the knife; and if the surgeon will thoroughly protect these surfaces by means which I will enumerate later, that accident can never occur.

The bugbear that interference with purulent or tuberculous foci will result in constitutional infection is not borne out by clinical

observation. I have never seen it, and I do not believe it ever occurs. Now all of the 50 per cent. of serious cases alluded to would at the time of incision, on account of the intelligent exploration of the joint by the surgeon, receive proper scientific care. We can see that mortality would be diminished or done away with; that excisions, on account of extensive bone disease, the result of primary and secondary infection, would be avoided. Therefore I contend, and I contend it without fear of successful contradiction—and it is sustained by clinical observation of over fifteen years in hundreds, and I might add in thousands of suppurating joint diseases which I have observed—that every one of these cases should be at once intelligently explored. One bird does not make a summer; and thirty-five cases of abscess of the hip selected and reported to the Academy of Medicine by Shaffer, and the occasional reporting of successful cases of abscess treated by aspiration, revived and recommended by Gibney, followed for years by myself and afterward discarded, because the results were extremely unsatisfactory, should have no weight against the rational treatment of these abscesses based upon etiology, pathology, surgical bacteriology, and clinical observation. The aspirator lulls the surgeon to sleep. He never knows whether he has aspirated an abscess due to a synovitis or one due to extensive bone disease, with sequestra or a separation of the head of the bone from the neck, requiring an immediate excision.

Up to two years ago it was extremely difficult to operate upon suppurating hips and prevent subsequent suppuration. But with the advent of the use of pure carbolic acid, as I reported at the last meeting of this Association, I have had no difficulty with such joints. The profession is indebted to Dr. Seneca D. Powell, of New York, for one of the most useful discoveries ever made in surgery. I allude to the antidotal effect of alcohol to pure carbolic acid. Powell has used carbolic acid for years in the treatment of infection and bone diseases in various parts of the body, and had recommended it for erysipelas and abscesses. I have tested it in the treatment of erysipelas, and find it as much a specific for that disease as quinine is a specific for malarial poisoning. Observing his good results in bone and other abscesses, I applied it to joint abscesses. There should be absolutely no difference in the treat-

ment of abscesses of the joint and the abscesses occurring in any other portion of the bone or in soft parts. My observation during the past two years has demonstrated to me the correctness of this statement.

Now we all know that pure carbolic acid cannot be absorbed. How is it that it acts beyond the area of disease? For instance, in erysipelas of the skin the deeper lymphatics are all involved. In hip-joint disease the bacteria have found their way into the lymphatics remote from the joint, and prior to my use of carbolic acid I frequently found abscesses appearing an inch or more from the field of operation. I can only explain it upon a theory, and that is that carbolic acid unites with the albumin of the tissues, forming an albuminoid or albuminate which is a powerful antiseptic. This new compound is absorbed into the lymphatics, destroying the bacteria. It must act in this way, because we observe in erysipelas the temperature, six hours after its first application, infrequently falls to normal. In hip-joint disease we observe after its application that the temperature may fall from 104° or 105° to 99° or 100° in twelve hours, and it will not rise again unless other foci of disease develop.

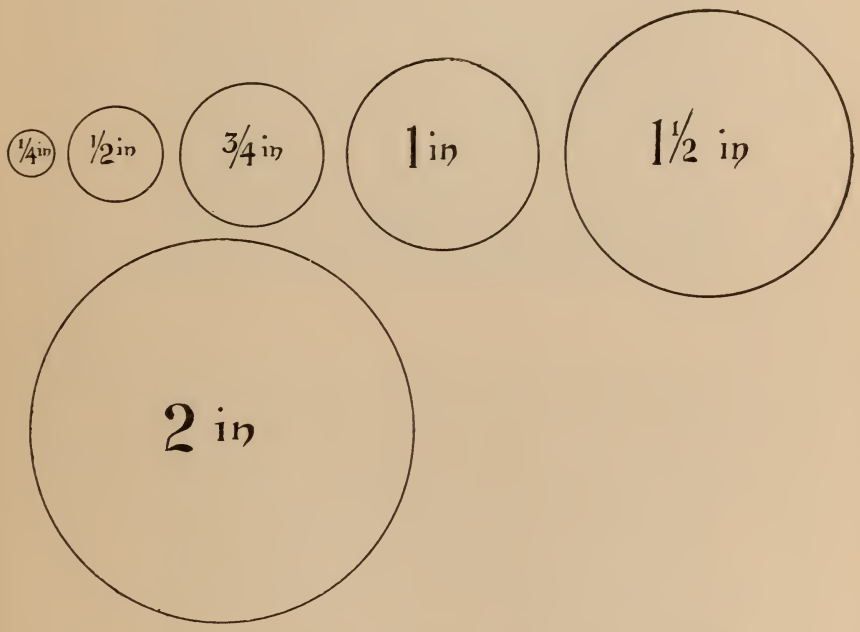
Now the method of its application is simply this: The abscess cavity is laid open. The opening into the capsule is found enlarged and the joint explored. If there is extensive bone disease the incision is lengthened and the capsule of the joint freely divided one-half to two-thirds its entire circumference, the head of the bone pulled out from the socket, the curette freely used, and the joint thoroughly irrigated with bichloride solution 1 to 1000.

The joint is now filled full with pure carbolic acid. It is allowed to remain one minute, by the watch, after which the joint is thoroughly washed out with pure alcohol, and, finally, the alcohol is washed away with a 2 per cent. solution of carbolic acid.

Instead of packing the wound or sewing it up, or introducing the collapsible rubber drainage-tube, *I use the largest glass speculum tube that the cavity will take, which extends down to the joint and is just flush with the skin.* This tube not only admits of perfect drainage, but enables the surgeon to see, day after day, just what is taking place in the joint. If further suppuration or extension of disease takes place, it is usually treated through this large glass

tube by curetting and the use of carbolic acid and alcohol. Packing is introduced through the tube to secure perfect drainage from the joint. These tubes vary in size from half an inch to two and one-half inches, and are of various lengths. A drainage-tube for a small child should be about an inch in diameter. In other words, the glass tube is fitted to the parts as large as they will take, and one can readily see the immense advantage the surgeon has, day after day, if he can examine the diseased area down to the very bottom of the joint. The tube is worn until granulations fill in from the bottom of the wound.

FIG. 1.



When it is not necessary to curette away pieces of dead bone or foci of disease in the neck or head, the wound can be closed with a smaller drainage-tube. From nine to twelve pounds of extension is applied during the bed-treatment, after which my splint and crutches are adjusted and the patient sent home. I have also observed that where disease exists in the acetabulum, particularly if the head of the bone is involved, it is better to remove the great trochanter,

because this bony prominence interferes with the drainage from the joint. Its removal in no way impairs the usefulness of the limb. If there is very extensive disease in the great trochanter I invariably remove the head and neck and great trochanter, because I have observed that in the attempt to save these structures it was impossible to destroy the disease, which was bound to progress in the acetabulum. There have been some exceptions to this rule, but where it is so persistent I now perform a complete excision in such cases.

If the abscess has burrowed into the iliac fossa I immediately detach Poupart's ligament from the anterior-superior spinous process and the attachment of the abdominal muscles to the crest of the ilium sufficiently to allow a free view of the iliac fossa. If disease is extensive, and the abscess extends back as far as the sacro-iliac synchondrosis, a drainage-tube is put through from this point to the back.

Now, in regard to results in the seventy operations which I have performed: In these seventy operations in former years I would have performed at least fifty excisions. As it is, in the seventy operations I have performed twenty excisions. In all of the other cases the joints have been freely opened and portions of bone and cartilage which were found dead in the joint removed in nearly every one. In fifteen of the cases the head of the bone was found separated from the neck and laid as a sequestrum in the joint. In thirty cases the disease was confined to the acetabulum, with some secondary infection of the neck of the bone. In twelve cases the abscess had burrowed into the iliac fossa, necessitating an operation there. In forty cases the capsule had ruptured anteriorly into the iliac muscle, finding its way into the iliac fossa or into Scarpa's triangle. In two cases the abscess had gone through the thigh from Scarpa's triangle and had appeared in the gluteal fold posteriorly, photographs of which I show you here. Fifteen excisions of the hip left the hospital on their splints four weeks from the day of the excision, three left the hospital at the end of two months, two required subsequent operations, one of which left the hospital at the end of four months, and the other, with extensive disease of the pelvis, has been in the hospital five months, and will be discharged within a week or two, and three more were reported

operated on last week. All of the cases requiring excisions or extensive bone operations were discharged from the hospital on an

FIG. 2.

FIG. 3.

average of three weeks from the time of the operation, wearing hip-braces or crutches. The wounds were firmly closed in all the cases excepting those otherwise reported.

When I compare these results with what I observed before I began the use of carbolic acid in the treatment of these joint suppurations I am highly pleased. In certain hospitals, I am informed, the wards are filled with patients with suppurating hips, many of which have been there for years. All such cases could be gotten up and out on hip-splints and crutches in a few weeks at the outside.

I am led, gentlemen, to speak thus positively because of the brilliant results and a desire to impress upon the orthopedic profession the principles which are accepted and taught in the surgical world. I believe that we, as orthopedic surgeons, have no right to violate established scientific surgical laws.

I wish to say right here that carbolic acid is used simply as an agent. It is not a specific in joint disease. Thorough surgical work, with the auxiliary of carbolic acid, to my mind, will accomplish more in the cases under consideration than any other means with which I am familiar.

DISCUSSION.

Dr. R. W. Lovett, of Boston, said that the incision of abscesses was a method of treatment that had been pursued for a number of years at the Children's Hospital in Boston, and with good results. His recollection was that they had had about 24 per cent. of abscesses. The surgeons had endeavored to prevent these by putting the patients to bed for a time whenever there was a painful condition of the joint or deformity due to irritative muscular action. He attached considerable importance to this preventive treatment. When an abscess occurred the joint was opened freely, and drained, after irrigation with corrosive sublimate.

KNEE-JOINT SURGERY FOR NON-TUBERCULAR CONDITIONS.

A Report of Thirty-eight Operations for Synovial Fringes, Injured Semilunar Cartilage, Loose Cartilage, Coagula, Exploratory Incision, etc.

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In presenting this subject it is my hope that from a study of the cases and in the general discussion something may be added to our knowledge of joint surgery.

The cases which are presented are those in which the knee-joint has been freely opened, either for diagnosis or to render the function of the joint more perfect. The cases in which operations have been performed which would tend to lessen the normal use of the joint, such as excision or erasion, are excluded, as are also all cases in which the operation has been performed as a part of the treatment of the septic or suppurative processes. All of the cases included in this series were at the time of the operation sterile so far as the condition of the joint was concerned.

In all of these cases the knee was the joint operated upon; but, while this joint must from its size and anatomical structure more often require such treatment, nevertheless the same principles apply to any of the other articulations.

The age of the patients varied from four years to sixty-five, and this fact seemed to be of about the same importance as in other operations.

There is, as you all know, a popular impression that for some reason it is more dangerous to open the large joints than any of the other large cavities; and, while this impression is less commonly held than formerly, yet even now, because of it, operations are refused

and patients are condemned to long courses of non-operative treatment, which frequently is not only inconvenient but may disturb to an irremediable degree the normal character of the joint structures.

The reason of this fear is undoubtedly very largely due to the serious results which attended such operations in the pre-antiseptic days, and the statements which are to be found in the text-books of those days have to a considerable degree influenced the writings of the more recent times. That opening a joint is more feared by the average surgeon than opening the cranium or the abdomen is partly due to these traditions, and is similar to the fear formerly felt in regard to these very operations which are now performed so commonly and so successfully. Similar changes will undoubtedly take place in joint surgery as it becomes more common and better understood, and the occasional unfortunate result will be overlooked in the great general good which will result from such work.

It is my personal feeling that there is no more danger in opening the knee or any of the other large joints than in opening the peritoneum. Neither operation should be performed carelessly or without due preparation; but in case the symptoms cannot be relieved in any other way there should be no hesitation in resorting to the operation. To go still further, if there is any question as to the diagnosis, and the doubt means otherwise a long period of inactivity, with the danger of destructive changes taking place which could be prevented, there should be no hesitation in opening the joint to determine the exact nature of the disease, so that proper treatment can be prescribed. It is practically impossible at times to differentiate between some of the beginning rheumatoid diseases and tuberculosis in the same stage, and yet it is at this very time that it is of the utmost importance to know the exact nature, as the treatment of the two conditions is radically unlike, and if sufficient time is allowed to elapse for the diagnosis to become clear the disease is so far advanced that nothing more than imperfect results can be obtained.

In children this question of doubt does not as often arise, as at this time of life the majority of subacute or chronic joint affections are tubercular, and, as in these tubercular cases early operative interference is so rarely indicated, exploratory incision is less often necessary. In adults, however, where the non-tubercular chronic joint affections are in the majority, and, as even in the

tubercular cases, early operation is so much more often the best treatment, there should not, it seems to me, be the least hesitation in determining through an exploratory incision the exact nature of the disease if it is not possible in other ways.

This, I am aware, is an opinion not as yet held by many surgeons, whether in general surgery or in the special branch which constitutes our specialty, but it is an opinion which becomes stronger and stronger each year, as the results are observed under the different methods, and I have not the slightest hesitation in urging its general adoption. As an illustration showing how impossible it is to differentiate between these different diseases, it has been my fortune during the past year to see one of the most hopeless, helpless cripples from rheumatoid arthritis that I have ever seen. This patient was treated for nearly two years by one of our best orthopedic surgeons for tuberculosis of the knees, first one showing the symptoms and then the other, and not until the other joints gave out was the real nature of the disease recognized. This is mentioned not in criticism, but to show how difficult it is to differentiate in many of these cases, even by those who are specially trained, and also to emphasize the importance of early diagnosis, as I feel convinced from seeing a large number of these cases in the different stages that if the exact nature of the disease in this case could have been known in the very beginning the result would have been very different. It is because of this great risk which is run by waiting in these doubtful cases that the exploratory incision is urged so strongly.

In my own work before this procedure was adopted there was the same uncertainty, and cases which were supposed to be one disease proved to be another, and harm resulted at times from too little treatment, and at other times from too much.

In determining the exact nature of the disease with the joint open, it has been found necessary to depend more upon the microscopic examination than upon the macroscopic appearance, as more than once a condition which was supposed to be non-tubercular has revealed the characteristic lesions of that disease in the microscopic preparation, and *vice versa*.

Of the cases which are reported, there are thirty-two patients and thirty-eight operations. In five cases both knees were operated

upon; in one case with displacement of the semilunar cartilage a second operation was necessary.

Of the thirty-eight operations, one was for removal of several loose pieces of cartilage. This patient was a woman of sixty-five years, and the only point of special interest is the origin of the loose pieces. Three pieces as large as hickory-nuts were removed, and were without question some of the osteo-arthritic nodes which formed a ridge at the edges of the cartilage of the femur, these, because of their size, having been broken off at some time in the joint motion.

Two of the operations were performed upon a case of irreducible dislocation of the patellæ of many years' duration, in which very extensive plastic operations were necessary to hold the bones in place and restore the function of the joint. This case has been previously reported (*Annals of Surgery*, January, 1899), and is here mentioned to show what extensive operations can be performed upon the knees without interfering with the normal function of the joint. In both knees it was necessary to leave a gap in the capsule of the joint on the outer side fully an inch and a half wide and several inches long. This was closed only by the skin and superficial tissue, and yet one joint is normal in its function, and in the other there is only some limitation of extreme flexion.

In one case the exploratory incision revealed a beginning osteo-sarcoma.

In one case the operation showed the symptoms to be due to osteo-arthritic nodes.

In five cases the nature of the disease by incision was shown to be tubercular, and appropriate treatment was prescribed. The incision did not change the course of the disease, but that which up to that time had been uncertain as to diagnosis was made clear.

Semilunar Cartilage. Nine of the operations were for the relief of symptoms produced by injury or displacement of the semilunar cartilage. In all of these cases conservative treatment had been thoroughly tried without success for various lengths of time, and the operation was performed as a radical cure. These cases have been of considerable interest, especially as contrasted with the cases which have been treated without operation, and a more careful study may not be unprofitable.

All of the patients were young, and, with one exception, were young men. In all the inner segment of the cartilage was the portion affected, while the cause of the original trouble varied. In some there was severe injury, while in several nothing more than turning quickly or going up stairs was the explanation. The cases which have been brought on by such simple movements have all had lax joints, and the pinching or tearing of the cartilage has undoubtedly resulted from the unnaturally free motion. In a closely "knit" joint with firm ligaments, apparently considerable force is necessary to make the motion possible that will bring about this result.

The lesion which has been present in these cases has not been as I had expected—a dislocation of the cartilage due to rupture of the ligament which held it in place, but a crushing and laceration of the cartilage at some one point with or without a rupture of the ligaments. In four of the cases the ligaments were intact at the time of the operation, the lesion being a crush or tear of the inner edge of the cartilage. In two of the cases there was a tear one-quarter of an inch long into the cartilage from the inner edge, and this inner edge commencing at the tear was folded over onto the rest of the cartilage, forming a ridge on which the femur caught in motion. With this condition present it is readily seen that a comparatively slight violence would tear the cartilage entirely across and away from its attachments. Clinically I am sure that I have seen this condition take place, where, after occasional slight catches causing comparatively little inconvenience, there has been a more severe catch associated with the protrusion of the cartilage, as a small hard substance on the inner side of the joint, and which can usually be slipped back by careful manipulation. These cases at the time of operation have shown a badly torn cartilage more or less detached. In one case over an inch of the cartilage was entirely free except for a small bit of ligament, while in still another, with a piece nearly as large, even this attachment was lacking.

The point at which the crushing has taken place in all of these cases is at the curve made, where the anterior portion joins the lateral portion, and if the piece is finally torn free it is the piece anterior to this point. In the operation this anterior portion, which represents about one-third of the whole, has been the part removed, except in one instance in which, as the result of a foot-ball accident,

the ligament was torn more extensively, and in this the whole inner cartilage was removed.

For treatment, in two of the cases the cartilage was stitched into place. One of these relapsed and was entirely removed later. The other case, a woman, when last heard from was well. In all of the other cases, representing the later cases, the injured portion was entirely removed, and this I am sure is the best operation. Suture of any kind, because of the structure of the cartilage, must be uncertain, and at the best necessitates a long course of carefully supervised protection of the joint afterward.

With the excision of the loose fragment the joint can be moved in a few days, and the after-treatment ends in from three to four weeks with no possible danger of relapse.

Synovial Fringes. In the remaining nineteen operations the symptoms were produced by masses of fibrin or unnatural folds of the synovial membrane, and as both conditions were usually associated they are included together in this report.

The folds of synovial membrane or fringes are undoubtedly present in any inflammatory process in or about the joint, and the membrane is thrown into folds because of its great vascularity, and that whenever for any reason the normal supply of blood is increased, the membrane becomes swollen, and as the firm and comparatively unyielding capsule prevents the membrane from increasing its size in its long axis, it must increase vertically, and the folds result similarly to the formation of the convolutions in the surface of the earth.

The size and extent of the fold depends upon the direct cause of the trouble. The simplest form is seen in the so-called dry joint, so commonly met with at middle life. In this type, in the general relaxation of the structures of the joint and the lack of tone of the muscles, the synovial membrane is relaxed, and, as is true of the other parts, the relaxed tissues become passively congested and swollen. The creaking or snapping is due to these folds or fringes slipping over each other, and in these joints there is little variation from the normal amount of fluid.

In the large majority of these cases under stimulating treatment that would tend to increase the tone of the part, the membrane resumes its normal condition, the creaking or snapping gradually disappearing as the strength returns.

If, however, this relaxed or swollen condition persists for any length of time, the power of contraction is much impaired, so that recovery is, at least, prolonged. Occasionally the folds which are near to the patella are caught in the articulation, with the result that the joint is more or less locked (depending upon the size of the fringe) and the fringe itself is bruised by the pinching and becomes swollen. It is readily seen that this swelling would make the fringe larger, so that it is more apt to be caught again if motion is allowed, and that while, if it is caught or pinched but once, it may retract to its former size, if this be repeated many times the membrane loses its elasticity, and a loose fold of synovial membrane or a true fringe results which remains, after the swelling of the rest of the membrane has disappeared, as a tab or loose fold hanging from an otherwise normal membrane. As this pinching in the articulation represents one of the chief causes of these permanent fringes, they are, of course, found chiefly about the patella.

After the fringe has once formed it is evident that it may at any time become caught between the bones, and the frequent acute attacks in these cases are undoubtedly to be explained in this way. It is also apparent that the joint may be locked by such a fringe similarly to the action of a loose cartilage, although the catch is not so abrupt or so complete as in the latter case.

The continued irritation, which must result from free movement of the joint, is followed by hypertrophy of the structural elements of the fringe, and results in the papillomatous appearance of what originally must have been a simple tab. As the irritation goes on, however, the hypertrophy due to the over-stimulation ceases and degenerative changes begin, following the rule which applies in other parts, that in processes of degeneration, structures of a higher order are replaced by structures lower in the scale. The change most common is fatty degeneration, and this has been seen in varying degrees from a small point of fat tissue to the replacement of almost the whole of the fringe, so that it existed as a lipoma inside the joint. In one case six or eight of these small lipomata or degenerated fringes were removed. In one case a calcareous degeneration was found, and in the membrane there were numerous calcareous bodies varying in size from the head of a pin to a good-sized pea, which, on section, showed true cartilage and bone

cells. These were entirely distinct from osteo-arthritic nodes, and were found between the layers of the synovial membrane instead of on the outside of the membrane, as would have been the case had the change been due to that process.

Associated with the fringes in most of the cases were masses of coagulated fibrin, free within the joint, varying in size from small flakes to, as was present in one instance, a mass over an inch in diameter. These two conditions were so often associated and apparently are so similar in etiology that they are considered together.

Whenever, for any reason, there has been a large increase of the joint fluid it is possible that, instead of the fluid being absorbed as the inflammation subsides, the fibrin in the fluid may separate and form a coagulum. This, of course, has no color, but is simply a mass of white fibrin which moves about in the joint as a foreign body. The nature of the original inflammation does not seem to be of importance in the formation of these coagula, as is shown in the cases of this series.

One was a case of acute articular rheumatism which was referred for treatment, because after the active disease had subsided the knee-joints remained swollen in spite of all ordinary measures. In this case the diagnosis of the condition was made, and at operation the coagula were washed out with entire relief to the symptoms. The condition had also been seen in tuberculosis, in traumatic synovitis, in rheumatoid arthritis, and the largest coagulum of all was removed from a child who had had a small punctured wound of the knee which had been washed out with hydrogen peroxide through the original small wound.

It is evident at once that these coagula represent a foreign substance inside of the joint, and that they are capable of producing irritation and symptoms similar to other loose bodies. That the motion of a joint may be seriously interfered with by such a substance is not to be questioned, and the only difference between the symptoms produced by it and those produced by a loose cartilage is that which would result from the different density of the two structures.

It is evident also that as this fibrin may produce continued and frequent irritation, and that as continued and frequent irritation is the chief cause of the synovial fringes, these fringes are present in

most of the cases where coagula are present. The reverse of this statement is also undoubtedly true, and that as the irritation caused by the presence of these fringes may result in an increase of synovial fluid, the opportunity for formation of the coagula is presented.

As the operations have been performed the two conditions have usually been associated, but with varying predominance, and in the cases where both knees have been operated upon the two joints in the same individual have varied. In one the fringes have predominated, the coagula being of distinct secondary importance, while in the other joint the exact reverse of this has been the condition found.

Operation. The operations which have been performed in these cases have varied somewhat with the nature of the trouble. For the exploration or removal of the semilunar cartilage a longitudinal incision about two inches long, at or near the point of injury of the cartilage, has been, on the whole, satisfactory. This point of injury can usually be determined by careful examination before the operation, and in case a more extensive view of the joint is desirable the incision can be enlarged transversely.

For the cases in which purely exploratory operations have been performed, an incision two or three inches long either just inside or just outside the patella has been used, and this enlarged as much as necessary to determine the exact nature of the disease. Usually a piece of synovial membrane has been removed for microscopic examination.

Coagula could, of course, be removed through either of the above incisions, but where fringes are present an incision on both sides of the joint is desirable, so that the whole cavity can be explored. The fringes should be trimmed off, so that all the irregularities are removed. No attempt need be made to close the wounds, which are thus made in the membrane itself, and whatever bleeding there may be from these wounds can be satisfactorily controlled by flushing the joint with hot-water.

For closing the joint fine silk sutures have been used for the capsule, with silkworm-gut for the skin and subcutaneous tissues.

The preparation for these operations has been similar to that for any other sterile operation, the only thing of special importance

being rest of the joint for a few days previously, in case there is any evidence of acute trouble.

The after-treatment, unless the incision has revealed some serious disease, has consisted of complete immobilization of the joint for one week, plaster-of-Paris being the splint commonly used. During the second week most of the patients have been up on crutches, the dressings being removed once or twice daily for passive motion. During the third week a flannel bandage has been substituted for the stiff bandages, the crutches have been discontinued, and use, together with stimulating bathing, has been encouraged. During the fourth week all treatment except the stimulating bathing has been discontinued, and this has been kept up for varying lengths of time, depending upon the strength of the joint.

Results. The results in such a series naturally depend upon the nature of the condition for which the operation was performed.

In the cases in which the operations were purely exploratory the course of the disease was in no way changed.

The patients with whom the semilunar cartilage was at fault were well and at their usual occupations in four weeks, with one exception, a circus acrobat, who waited six weeks before returning to his work, the longer interval being the result of caution rather than disability. All of these patients are, so far as I know, well, with the uncertainty of usefulness, which was present before the operation, entirely removed.

The cases in which the symptoms were due to coagulated fibrin were naturally relieved by its removal, as was also the case of loose cartilage.

The fringe cases are improved in varying degrees, depending upon the nature of the disease which caused the fringes to develop. Where the fringes were simply the result of the weak or relaxed condition of the joints, as the result of the operation and the after-treatment, the joints are normal. The other cases have been improved in just such proportion as would be expected from the nature of the disease.

One patient with osteo-arthritis is, I think, worse for the operation, which apparently made the disease more active, a condition which has been observed in operations performed upon other parts of the body where this disease is active. From this result, together

with a similar result which I have seen in the hands of another surgeon, and from my experience with this disease in other parts, leads me to the conclusion that operation should be avoided upon any part where this disease is present, unless it has been for a long time quiescent.

Conclusions. The purpose of the paper is to show, by considering the results obtained in thirty-eight operations, that operations upon joints need not be feared more than operation upon other parts of the body, and because of this to urge the importance not only of operating to relieve a definitely recognized condition, but also to make use of exploratory incisions in the doubtful cases to determine the exact nature of the disease. Without this it is impossible in many cases to differentiate in the incipient stage between several different conditions, and it is at this very time that the most can be accomplished in the way of treatment if the exact condition is known.

Of the thirty-eight operations one was for the removal of a loose cartilage, two were for permanently dislocated patellæ, seven were for exploration to determine the nature of the disease, nine were for the removal of an injured or displaced semilunar cartilage, nineteen were for the removal of synovial fringes or masses of coagulated fibrin.

No unpleasant results followed the operations except in one, a case of osteo-arthritis, in which the disease was apparently made more acute. The exploratory incision did not alter the course of the disease. The cases from which the semilunar cartilage was removed have functionally normal joints. The cases in which the synovial fringes and coagula were removed are improved in proportion to the nature of the disease which caused the condition to be present.

DISCUSSION.

Dr. Stewart Le Roy McCurdy, of Pittsburg, congratulated the reader of the paper on this report of so many successful operations on the knee for disease of the cartilage. About fifteen years ago an interesting article on this subject had been written and published by a London surgeon, Allingham.

Dr. W. R. Townsend, of New York, said, regarding exploratory incisions, that he had personally treated one case over a year for what had seemed to be an osteitis of the knee. This diagnosis had been concurred in by Drs. W. T. Bull and Gibney. An operation was done for the removal of the tubercular material, and no permission was obtained for any further operative measures. On opening the joint they had been astonished to find that there was no tubercular process, but a sarcoma. This emphasized the importance of early exploration in order to make a positive diagnosis in doubtful cases. More and more of these deformities were coming to the orthopedic surgeon, and hence the latter must meet the demands made upon him and be ready to explore the joints at an early stage where such interference seemed warrantable.

Dr. T. Halsted Myers, of New York, said that he had under his care two cases of rheumatic arthritis, the patella being firmly ankylosed to the femur, but there being still slight motion in the joint. He had advised an operation to free the patella, but in both instances general surgeons had refused their consent. He would like to ask Dr. Goldthwait his experience in such cases.

Dr. Augustus Thorndike, of Boston, asked Dr. Goldthwait if he preferred any particular incision for exposing the knee-joint.

Dr. Goldthwait said that he did not wish it understood that he was presenting anything absolutely new. In the London *Lancet*, about eight months ago, an article on the same line was presented. The object of the present paper was to remove a dread which many surgeons seem to have of opening the knee-joint. He did not advocate incision in every case of semilunar cartilage displacement. All of his cases previously had conservative treatment, often by experts, and for a considerable time without benefit. The incision for semilunar cartilage cases had been a straight one, about two inches long, to the inside of the patella tendon. If it were thought best to remove the semilunar cartilage the incision was enlarged straight backward. For exploration of the joint two incisions had usually been made, about three inches long, on either side of the knee and about one inch outside of the patella. This

enabled one to explore the upper portion of the synovial sac. The capsule had been sutured separately in closing the wound. In regard to Dr. Myers' case he would not hesitate at all to free the patella, but the point of the paper was to try and recognize these cases before such adhesions form. He was perfectly sure it was possible to prevent such conditions if proper treatment were instituted at a sufficiently early period.

DISCUSSION ON THE TREATMENT OF VERTEBRAL TUBERCULOSIS, WITH REFERENCE TO THE FORCIBLE CORRECTION OF THE DEFORMITY.

Dr. John Ridlon, of Chicago, opened the discussion. He said that he had treated his first case in this way three years ago in June. Since then he had adopted the treatment in every case in which it had seemed possible and in which consent could be obtained. He had straightened two cases of rheumatoid stiffening of the spine, and had operated upon eight lateral curvatures under ether, and more than thirty-five cases of Pott's disease. One of the rheumatoid cases had been a woman of twenty-six years, and the other a man of thirty-four years. Both were very bad cases. In the first case he had not recognized the rheumatoid spine, and had looked upon it as a hysterical condition. He had given her ether to convince her that she could be straightened; but finding her still rigid he was curious to see what could be accomplished, and had accordingly resorted to forcible straightening in the lumbar and lower dorsal region. She had been retained in the improved position for several months, and then had a course of gymnastics. The good position had been retained and improved upon. This had been done two years ago. The other case had been operated upon about five months ago. Here the condition had been recognized beforehand. The plaster had been worn for eight weeks, and the patient was now wearing an antero-posterior spinal brace. It was entirely possible in slight, moderately severe, or very severe cases of lateral curvature to gain a very great deal. In the worst cases that he had treated he had gained at first one inch and a quarter in height, and at the second attempt three-quarters of an inch in height. In all of the cases of lateral curvature almost all that had been gained had been subsequently lost. He did not think it was worth while

now to straighten a lateral curvature case under ether. He had attempted to straighten one case of rhachitic curvature occurring in a boy who had been treated by Dr. Sayre when he was three years old. According to the photographs the deformity had not changed in seventeen years, and in this case he had gained nothing by the treatment. In another case, a child of five years, with posterior and lateral curvature, he very nearly straightened the lateral curvature, and completely straightened posterior deformity. At the end of two years the spine was perfectly straight, and there was little bulging on the side of the convexity of the ribs.

In Pott's disease he had operated upon both old and recent cases. One of the cases was of fourteen years' duration, and there had been no change in the deformity to his personal knowledge for four years. It had not straightened under any force which he considered safe. In a child of five years with a history of deformity for four years and a very bad high dorsal curvature, nothing had been gained by any force which he had thought safe to use. He had operated upon patients both with and without abscess and those with and without sinuses. There had been two fatalities. One of these had been operated upon before she had been in the hospital long enough to learn the temperature of the patient. Immediately after operation the child presented an elevated temperature, and this had been maintained during four weeks, or while she had remained in the hospital. On inquiry it was learned that the child had had a cough for two months before coming to the hospital, and death from pulmonary tuberculosis occurred two months afterward. The other fatal case was one having an abscess at the time of the forcible straightening. After the operation the abscess was no longer apparent to sight and touch, and the child did well for six or eight months. Then two or three abscesses developed, and death eventually occurred from the exhaustion consequent upon prolonged suppuration.

The operation seemed to him a reasonably safe one if done with proper care. He had used no mechanical device for the stretching. In small children two assistants and in larger ones four assistants had made the traction on the arms and legs and head. In some cases the child had been pulled until there was no longer apparent ability to expand the chest in breathing. He had not cared to go

further than that. In many cases he had used almost no pressure with his hands; in other cases the force had been very considerable; and in three or four cases he had used as much force as he could exert with both hands. There was almost always some crunching of the bones, which was startling at first. None of his cases had had paralysis develop subsequently. He had operated on several cases which had been paraplegic at the time. In some of these the paraplegia had diminished very rapidly, the limbs becoming pink and warm within a few hours, and movement returning. In one case acting in this way the paraplegia had returned a few weeks later while the child was still in bed, and a second operation had lessened the paraplegia, but had not caused it to completely disappear. In the earlier cases he had hung his patients up by the heels, as recommended by some of the French surgeons, but had found the method unsatisfactory. He had never hung them up by the head. He had then tried supporting the head and pelvis, with the face down, while the plaster was applied. He had next turned them over before the plaster had hardened, and had bent them over the support. He had since used Goldthwait's frame in a modified form for greater convenience in use. He had applied pads in the region of the spine at times, one on each side; at other times only a single pad had been used, pressed well down between the supporting bars. This pad is made of Mexican felt, at least half an inch thick. Very frequently, in spite of this and every other precaution to prevent excoriation, there had been pressure sores over the knuckle. He had also used a pad of felt, one-quarter of an inch thick, over the sternoclavicular articulation, coming up on the neck and under the chin. This had prevented pressure sores in this region. Since using the Goldthwait frame he had never included the head in the plaster-of-Paris, and had thus saved his patients pressure sores and much discomfort. The shortest case had been kept in bed four weeks, and had then been taken away by the mother, contrary to advice. He had expected relapse, but this had not occurred. The case was one of lumbar spondylitis. The longest case had been in bed for about one year. He had aimed to keep them from six to eight months in bed, allowing them to lie on the face, back, or side. He had a few cases in which there had been no return of the deformity, and about half a dozen that had

gone for a year without any support and without any return of the deformity, although the straightening had been as much as half an inch to three-quarters of an inch. In a few cases the deformity had returned and become almost as marked as before the straightening. These had usually been cases of long-standing disease of the dorsal or upper lumbar regions. In the majority of cases he had succeeded in keeping the deformity reduced to about half what it had been before the operation. He had put these cases in antero-posterior braces anywhere from two months to one year after the straightening.

Dr. Joel E. Goldthwait, of Boston, said that during the last two or three years the common treatment of Pott's disease at the Children's Hospital had been the use of plaster-of-Paris jackets applied in the hyperextended position, various devices being used to obtain this position. At first a number of the cases were straightened under an anæsthetic; since then anæsthesia had been given up, and the mere weight of the child had been depended upon to effect the correction. He had had made out for him a list of those who had been coming to the plaster-room for the last few months, and without any selection tracings had been copied from a considerable number of the cases. The list had been compiled by one physician and the tracings had been prepared by another, so that personal prejudice had been eliminated. These tracings were all taken during the period in which the hyperextension treatment had been in use. It was evident from the tracings exhibited that the deformity at the seat of the disease had not increased, or only very slightly. Some of the tracings showed, however, an increase of the compensatory curve. Of the cases that had been forcibly straightened, two tracings were exhibited. One case had been treated in February, 1898. Ten days after the straightening the jacket had been removed and reapplied without ether. The deformity had relapsed somewhat, as is shown. Since then the child had been wearing jackets applied regularly with the spine hyperextended. The tracing at the present time showed a marked increase of the lumbar compensatory curve. The knuckle was practically the same as it was two years ago, before treatment was begun. The second tracing was that of a woman of about twenty years, who had been paralyzed

FIG. 1.

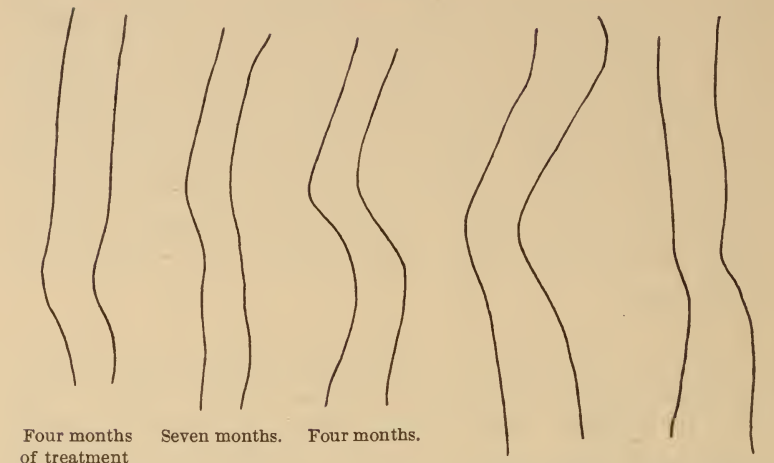


FIG. 2.

a. Before straightening under ether. *b*. Immediately after. *c*. Ten days later on removal of jacket. *d*. Position on the frame just before new jacket was applied. No ether being used, the correction resulted simply from the body weight. *e*. Tracing taken two years later after continuous treatment with jackets applied in the hyperextended position. The dotted line is the tracing taken at the beginning of treatment, and is almost identical with the condition as seen in the last tracing. There has been a relapse to the old deformity, but no increase beyond this. The other change is in the compensatory curves. *x*. Tracing taken before complete straightening under ether. *y*. Tracing taken two years later, showing a relapse to the old condition, but no increase beyond this.

about two years before the deformity had been straightened. The back had been made practically straight at the time of the operation. The paraplegia had been relieved. The present tracing showed no material improvement over the first one before the operation.

Two years ago he had stated before the Association that, from the nature of the disease, it was unreasonable to expect a permanent improvement, as the disease was one which did not lead to the repair of the bone and tissue destroyed, and the opinion had been expressed at that time that if the cases could be seen early, and treated in the hyperextended position, the deformity could probably be held and possibly slightly reduced. The results of two years' work has been wholly in keeping with this opinion. At the present time he had a man, aged forty-five years, who had been under continuous treatment for two years, and had been in bed most of the time. He had been paralyzed for four years. He had been gradually improving. His back was quite straight at present, but he was convinced that as soon as the man was allowed up the deformity would relapse to its former condition. As a result of the work of the last two years, he would hesitate before he would be willing to forcibly correct any spinal deformity resulting from tuberculosis, unless with it there was paraplegia which could not be relieved by less vigorous measures. In the latter condition he would perform the correction with the idea of relieving the pressure, holding it for a sufficient length of time for the disease to quiet down, and thus save the patient the long confinement in bed which was otherwise necessary.

Dr. W. R. Townsend, of New York, presented for Dr. Gibney certain tracings, to give an idea of the work on forcible correction done at the Hospital for Ruptured and Crippled. The first cases had been done in March, 1898, and the last, the tenth, in August of that year.

Dr. Townsend, speaking for himself, said that the method had never appealed to him personally. He had preferred the use of the Goldthwait frame to the Calot method. He had never thought there was any reason to believe that the treatment could effect a permanent cure, and he predicted that there would be a recurrence of the deformity in the large majority of cases. There had been no deaths under this treatment at the Hospital for Ruptured and Crip-

pled. At the present time the method in vogue in that hospital was the use of the Goldthwait frame without anæsthesia.

Dr. De Forest Willard, of Philadelphia, said that theoretically forcible straightening had always seemed to him so illogical and unsurgical that he had been perfectly satisfied to allow other surgeons to test it. He had only employed it in the single case described in the present volume,[1] one which he had watched for more than two years before he had attempted this treatment. The patient had been totally paralyzed for a long period of time, had two or three bed-sores, and was in a desperate state. Contrary to his expectations, the result had been beneficial, but it was just in this class of cases alone that the method seemed to him at all indicated. Ordinarily we should not attempt to break up the adhesions which nature has formed in the endeavor to repair the carious damage. Therefore, only in a few selected paraplegias of long standing did the operation seem to him justifiable.

Dr. R. H. Sayre, of New York, thought the tracings that had been exhibited emphasized what had been said already by Dr. Lovett—*i. e*, that the great thing needed in Pott's disease was to protect and control the spine and prevent it from becoming deformed. If the spines represented by these tracings could be held for from nine to twelve months with practically no change, and some protective influence had been exerted before the deformity had reached this state, an equally good result should have been obtained as was represented in the tracings. He had had no personal experience with the forcible correction method, because he thought it should be employed in only a few exceptionally bad cases. The question of lateral curvature had been introduced by Dr. Ridlon, and in this connection he would say that he believed many cases of severe lateral curvature could be greatly benefited by the application of great force under an anæsthetic. The amount of force applied to these scoliotic spines was altogether insufficient to make much impression on them, and the pain incident to such pressure was more than a patient could endure. By longitudinal traction and torsion under anæsthesia he believed much could be accomplished.

[1] See article on "Spinal Caries Paraplegia; Forcible Reduction in a Long-standing Case. Immediate Benefit and Rapid Recovery."

Dr. T. Halsted Myers, of New York, said that his experience with forcible correction had been limited, but unfortunate. The first case was a man, fifty-four years of age, who had been paraplegic for some months. Shortly before the speaker had seen him the spine had been forcibly corrected by another surgeon, but following this there had been a rapid onset of acute symptoms of tuberculosis, and he had soon succumbed to this disease. Another case treated by recumbency apparatus five years ago had recovered from his paralysis. Contrary to advice he had subsequently indulged in shooting, and this led to a return of the paralysis. The treatment had then consisted in suspension at intervals for two or three months, when improvement had ceased. A plaster jacket in hyperextension was then applied. Within six months more he had become absolutely paralyzed, and had then succumbed to an intercurrent pneumonia. A third case, showing a possible cause of failure to relieve symptoms by this treatment, was that of a boy who had been cured of Pott's disease when five years old, but leaving a marked deformity. Paraplegia reappearing rather suddenly, he was straightened considerably by the use of very moderate force, simply being made to lie in pads placed at the kyphos, but there had been no improvement in the paraplegia, and after about three months the symptoms had begun to increase. After consultation with another surgeon and with a neurologist, operation had been advised and undertaken. This showed an old tubercular process and a recently formed tuberculous tumor on the posterior surface of the cord. The latter had been responsible for the later symptoms. In a fourth case which had been forcibly straightened by another surgeon the deformity had recurred. In that case the deformity had since been kept unchanged by braces. Theoretically the operation seems illogical, and these results, namely, a death hastened, a failure to improve, a pathological condition precluding improvement, and a relapse, illustrate some of the practical objections to the operation.

Dr. H. P. H. Galloway, of Toronto, asked Dr. Ridlon how much difficulty he had met with in straightening the cases of rheumatoid spine, and also whether it had remained in the straight position. The speaker said he had never performed the operation of forcible correction, having always regarded it as unscientific, but

had held it in reserve for his first case of paraplegia from Pott's disease incurable by other methods. Such a case had not yet presented itself. He was now treating a larger number of these cases by recumbency with the spine in a hyperextended position—in other words, applying the principle of the Goldthwait frame up to the point of applying the plaster jacket. The patient is placed on the frame in bed at a considerable inclination. A pad is placed under the spine of sufficient size to keep it continually in a hyperextended position. During the past year he had treated by this method two severe cases of paraplegia. In one the symptoms had developed very acutely in a child about two years and a half old. The disease had only existed for a few months previously. The day after the child had been placed in this hyperextended position there had been considerable improvement in motion, and this had continued until the disappearance of the paralysis. The child had been kept with the spine hyperextended for seven or eight months before applying the brace. It was now running about and doing well. In another case of much longer standing, and where the condition of paraplegia had not been recognized by the attending physician, the disease being high up in the dorsal region, he had experienced much more difficulty in carrying out the treatment. He had become discouraged at the prospect of improvement by the usual methods, and had even recommended forcible correction, but just about this time improvement had commenced, and the child was now practically well as regards the paralysis.

Dr. Stewart Le Roy McCurdy, of Pittsburg, said that he had been accustomed to classify these cases in three groups, viz.: (1) The old cases which require an anæsthetic and considerable force for correction—a class of cases in which he had had very little experience; (2) the cases of paraplegia in which forcible correction might benefit; and (3) the cases under active treatment where there was a beginning knuckle, which gradual but forcible correction seemed to improve. In the last class it seemed to him that the treatment should be instituted quite early.

Dr. Louis A. Weigel, of Rochester, N. Y., said that he had no personal experience with the method, because he preferred to await

the results reported by others before undertaking it. If the correction secured could not be maintained, as the reports seemed to indicate, it is a question whether the means of fixation adopted are efficient.

Dr. R. Tunstall Taylor, of Baltimore, said with regard to Calot's method, that he had used it in four severe cases, two being paraplegic. In none of the cases had he been impressed with the ultimate gain, nor with the accuracy of the method as compared with mechanical treatment to accomplish the same aim. Such extreme force was apt to do violence to structures which should not be disturbed. In none of the cases had any untoward symptoms developed, however, nor had there been any mortality. Possibly sufficient force had not been used, although six assistants had made traction, but the results had not appealed to him. Granting that in a severe case the deformity might be obliterated by such extreme force, one could not be sure how solid such a spine might be ultimately and how soon the gap could be filled in by the reparative process, if at all. The mechanical methods were safer, could obtain correction by degrees, were more accurate, and did not introduce the errors incident to the use of a mode of procedure involving the manipulations of several individuals. The latter seemed to him quite an important point. In cervical and upper dorsal cases even hyperextension seemed to him of little avail, especially if the deformity was marked and had existed for a long period. In mid-dorsal, lower dorsal, and lumbar curves methods of hyperextension could accomplish much. It was of the greatest importance that these jackets should be amply padded with felt, and that such means should be used that the *exact shape of the spine* might be seen *at all times* during the application of the jacket, in order to arrive at a true estimate of the gain made. The forcible straightening, then any moving of the child to some other position, and applying the jacket, seemed to him an inaccurate method. With the kyphotone he had been able to obliterate the deformity of the severest form in "early" cases.

Dr. Phil. Hoffmann, of St. Louis, said that great stress had been laid upon the use of forcible correction in cases of paralysis. He would like to ask if nearly all cases would not recover if the

spines were rigidly immobilized and the patients were kept upon their backs. He suggested that the good results as regards the paralysis might be in large measure due to the rigid support applied to the spine immediately after the forcible correction, and the placing of the patient in bed. In his city it was the custom to apply a spinal support and to place the child in bed, preferably on a stretcher-splint. He had never seen a case of Pott's paralysis under two or three months' duration that with proper treatment had not recovered.

Dr. John L. Porter said that he had seen a large percentage of the cases reported by Dr. Ridlon in the first discussion of this subject, and he regretted very much that Dr. Ridlon had not exhibited here the tracings of many of his cases, as he felt sure they would give the Association a very different impression. From his observation of these cases he felt sure that more than 50 per cent. of them were straighter now than when operated upon. They had been operated on under anæsthesia. It had occurred to him in the use of the Goldthwait frame that perhaps a large percentage of the improvement observed when the jacket was first applied was due to the compensatory lordosis shown so well in the tracings exhibited by Dr. Goldthwait. The pressure sores developing under plaster-of-Paris jacket had been largely prevented in the later cases by fenestrating the plaster over a well-padded kyphos. The cast should be carried up in front as Dr. Ridlon had described. Sometimes the plaster was carried over the shoulder in strips; sometimes it was omitted.

Dr. Ridlon, in answer to Dr. Galloway, said that the last rheumatoid case had not gone without a spinal brace, and he did not feel certain regarding the permanency of the increased mobility which now exists. As to the case operated upon two years ago, and which had been without support for a year and a half, the mobility in the region of the straightened portion of the spine was very greatly increased, and was very nearly as good as in the average spine of an individual of the same age. He was surprised to find this. He had not mentioned any of the cases that he had straightened without anæsthesia. Whenever the patient had refused an anæsthetic, since Goldthwait

had first described his method, Dr. Ridlon said he had resorted to extreme hyperextension without an anæsthetic. He felt sure that he had had as good results as had been presented here, and he was inclined to believe that they had been even better. In reply to Dr. McCurdy, he would say that he had straightened, under an anæsthetic, during the past three years every case in which he had secured consent. Many of them he had not expected to improve. He would not attempt to break up a spine that seemed to him entirely cured. This was one class, therefore, which should not be chosen for forcible straightening under an anæsthetic. For the same reason, in very recent cases, where the weakness, pain, and disability were considerable, he would be disposed to choose Goldthwait's method, without anæsthesia. It was the middle class of cases that had had a slowly increasing deformity for a considerable time that were especially suitable for forcible straightening under an anæsthetic. He would certainly try to straighten every one of the paraplegic cases. He believed that almost every case of Pott's paraplegia, if kept recumbent long enough, would recover the use of the legs. One of his cases had recovered after recumbency for a year, and had then relapsed and had not recovered under another year of recumbency. In this case improvement had followed in a few hours, and this he explained, not by chance, but by the forcible method of treatment. He had been surprised at the little gain which Dr. Goldthwait had found by his correction-method without anæsthesia. The discussion had impressed him deeply, therefore, with the great value of using an anæsthetic. Next year—*i. e.*, when four years had elapsed since beginning this work, he hoped to be able to give a final report on some of the cases.

Dr. Goldthwait said he thought there was unquestionably a correction produced at the time of the application of the jackets, but this was not permanent. He had purposely not brought other tracings of cases treated under anæsthesia because he had no better ones to exhibit. Regarding recumbency for a long time after making the correction, the speaker said he had not observed much difference in the cases which had relapsed whether they had been kept in bed or had been allowed up in a short time.

Discouraging as the tracings appeared, they were an immense

relief to him. A few years ago he had had the tracings collected at the Children's Hospital, covering a long period of time, but he had never exhibited them because of the common and frequently marked increase of the deformity shown in them. The fact that it was possible by this measure to prevent an increase of the deformity was to him a great comfort. The case reported by Dr. Willard did not seem to him an exceptional result, as many other similar cases had been presented. Hubbard's cases, presented to this Association some years ago, showed that cases of Pott's paraplegia recover in from six to nine months, as a rule, the time depending upon the location of the disease. But the forcible correction or hyperextension method greatly reduces this period of recumbency. He would not attempt forcible correction unless paraplegia were present, and he would never use traction or much force to bring about the correction. The amount of force employed and the method adopted were matters of importance. His own custom had been to have the child anæsthetized and placed on the back. The operator then places one hand under the kyphos and the other high up on the chest, and the child is bent backward. If the deformity could not be corrected in this way he would not attempt forcible correction. Two of the tracings presented represented disease in the fourth dorsal vertebræ, which had been successfully treated without the use of any head support. Excoriations should not occur. Every case of acute knuckle should have a window wide enough to prevent pressure upon the spinous processes.

THE SCORBUTIC SPINE.

By JOHN RIDLON, M.D.,
CHICAGO.

On October 17, 1899, in consultation with Dr. Frank Cary, I saw a male child, twelve months old. This was the only child of healthy parents, and he had been given all the care bestowed upon the first child by interested, intelligent, and wealthy parents.

The mother gave the following history: The birth was normal. For the first two months he was nursed; for the third month he was nursed and bottle-fed arternately, the food being Walker-Gordon modified milk; for the fourth and fifth months he had the same milk without being nursed; from the beginning of the sixth month up to the time of the examination he had been fed on Gurler's milk, sterilized, and imperial granum. With the exception of some constipation he had been an exceptionally healthy child.

On September 21, 1899—that is, twenty-six days before this—the child began to cry as the nurse carried him into a rockaway carriage; he cried for two hours, and seemed to favor the left knee. It was assumed that the knee had been hurt. An eminent physician examined the child within an hour and told the mother there was a slight contusion of the knee, for which a cold compress was applied for twenty-four hours. The child then seemed much better. Three days later an extension high-chair, with the baby in it, dropped about a foot, and again the child had a crying spell. Again the child was examined by the physician, who found nothing. (Indeed, the physician does not now remember that he found any injury of the child at any time.) Nevertheless, after this the child became gradually worse, was less and less inclined to kick and play, and exhibited more and more pain on being lifted and moved, until in the course of a week he was carried about on a small mattress. The

family returned to Chicago, and on September 30th the child was carefully examined by an eminent surgeon, who found nothing, and told the family that there was nothing the matter. After this examination the child was much worse. Not only the left knee but both hips appeared to be disabled, and he moved the legs very little. Three days after the examination by the surgeon Dr. Cary was called, and the question of rheumatism was considered. The child was put upon anti-rheumatic medication, but showed no improvement. Gradually he used the upper extremities less, and it appeared as if they were being affected in the same manner as the lower extremities. This was the condition of affairs when I saw the child on October 17th.

Examination showed a large, fat baby, with a rough and muddy skin and no color in the cheeks. The face showed evidence of suffering; the legs were held slightly flexed at knees and hips; there was no inclination to kick them about; he moved the hands more, but did not fight with them as does a healthy child. Any passive movement of the legs caused crying, but the range of motion at the ankles, knees, and hips was normal. Then by rolling the child on a blanket he was turned on his face, but not without evident suffering. The spine was arched forward and held rigid throughout its entire length; attempts at passive motion caused crying. There was no swelling or redness anywhere, and no deformity except the arching forward of the spine. The mouth showed a somewhat coated tongue and dusky gums.

Despite the fact that only one[1] scorbutic spine has been heretofore recognized, I felt justified in making that diagnosis, and directed feeding on unsterilized milk, scraped raw meat, and orange-juice. Eighteen days later, on November 4th, I saw the child again. He was well. The skin was clear and rosy, the cheeks red, the tongue clean, the gums had lost their dusky hue, the spine was no longer stiff, there was no crying on passive motion, and he kicked his legs and crept about as lively as the liveliest.

The cases of infantile scorbutus that I have found reported, with the single exception above noted, have presented bony lesions only in the thighs and legs and occasionally in the forearms. The symp-

[1] H. L. Taylor. Transactions of the American Orthopedic Association, vol. vii., p. 129.

toms have been anæmia, dirty, sallow complexion, hard and dry skin, spongy gums, local tenderness and swelling, and inability to use the limbs. The muscles have been flabby, and at times wasted. The children have been irritable, fretful, and disinclined to be handled. After four or five weeks there have been found swellings and flexion deformities, and finally bleeding of the gums, ecchymoses about the eyes, purpuric spots, hæmaturia, and intestinal hemorrhage. In the cases that I have seen the onset has been sudden, and it has been thought by the mother that the child had sustained an injury.

In the differential diagnosis of this case we have to consider rickets, Pott's disease, infantile paralysis, and rheumatism. Acute rheumatism is rare in infants, and is always accompanied by a general elevation of temperature. There was no elevation of temperature in this case. The same may be said of the onset of infantile paralysis; in this case the result excludes infantile paralysis. As to Pott's disease, the onset is not as sudden, the progress is not as rapid, the entire spine is not held rigid to gentle manipulation, and the result would be quite different. In rickets the onset is gradual, the spine is bowed backward and not forward, and the spine never becomes stiff and sensitive to manipulation without other characteristic evidences of the disease. It appears to me that no other diagnosis accords with the symptoms presented at the time of my first examination, and none other accords with the results of the treatment. A letter from the patient's mother, dated April 17, 1900, six months after I first saw the child, informs me that the child has continued in perfect health.

DISCUSSION.

Dr. R. H. Sayre, of New York, said that he thought the scorbutic spine had been recognized years ago. He had seen several of them, one about six years ago. He recalled one marked case which he had treated by placing the child in a cuirass and changing its diet. It had recovered so rapidly that the parents have assured him that his diagnosis must have been wrong. His plan has been to put the child on a pillow with a shirt-board inside of the pillow,

and bandage the child to it. In addition to this mechanical treatment the diet was suitably changed. Almost all the children so affected that he had seen had been fed either on sterilized milk or on patent infant foods. One child had had an extremely tender spine, and also complete paralysis of the lower extremities. He believed the paralysis was due to an effusion pressing upon the cord, and the same cause was to be found in the cases of infantile paralysis beginning with complete paralysis. The pathology of such cases was obscure, because none of them came to autopsy at the time of the existence of the lesion. Probably a part of the atrophy of the anterior motor cells of the cord was the result of the pressure produced by the effusion. In the child referred to, the paralysis passed away after some weeks. The knuckle which had been present in the spine and the tender spots elsewhere had all disappeared under suitable treatment. This was the only case that he had seen in which there had been paralysis of the lower extremities. Effusions in the soft parts were observed in regions where they could be easily examined, and it seemed reasonable to assume that similar effusions occurred in less accessible parts. In the scorbutic spines that he had seen there had been kyphosis, and not lordosis.

Dr. Phil. Hoffmann, of St. Louis, placed on record one case of scorbutic spine. The patient was a child about fourteen months old, and had been referred to him as a case of Pott's disease. The spine was held very rigidly, and there was a slight kyphosis in the dorsolumbar region. The rigidity of the spine and the kyphosis had led the attending physician to suspect Pott's disease. The child had had pneumonia a short time before, and the physician, thinking the mother's milk was not good for the baby, took the child from the breast and kept it for a number of weeks upon malted milk. After a time the scorbutic condition developed. The kyphosis was sharper than that found in the rickety spine. Examination showed the ribs and spine tender, and well-marked signs of scurvy. The child was placed on an ordinary recumbency splint—a steel frame covered with canvas—and was ordered to be nourished by a wet-nurse and to be given orange-juice. The child recovered very satisfactorily.

Dr. A. J. Gillette, of St. Paul, remarked that all cases of scorbutus that he had seen had had a decided elevation of temperature.

Dr. H. L. Taylor, of New York, said that he had reported a case of scorbutic spine very early in the history of scorbutus in this country—soon after the article by Dr. W. P. Northrup had appeared. The case was reported to this Association, with tracings of the spine, and published in Vol. VII. of the Transactions. The child recovered very promptly under the usual antiscorbutic diet, although its condition had been desperate. He had not found it necessary to resort to any special mechanical treatment. The pseudoparalysis of scorbutus had received considerable attention; it was very common for these children either not to move the extremities or to move them only a little. In the cases that he had seen there had been no true paralysis, but the limbs had been kept quiet because of the extreme pain caused by movement.

Dr. Stewart L. McCurdy, of Pittsburg, called attention to a report of two or three cases he had made several years ago, and published in *Pediatrics*. The article contained photographs and tracings of several cases of scorbutus. One case he had seen before the appearance of Dr. Taylor's paper, and the child died because he had not made the correct diagnosis. After seeing the reports by Dr. Northrup and Dr. Taylor all of his cases had been treated successfully. Kyphosis was not an exact descriptive term for these cases, as there was rather a gradual posterior curve resulting from the giving way of the muscular and ligamentous support under the pressure of the weight of the body. The curve had always been posterior in his cases, with perhaps a slight lateral curve. In some cases there had been a pseudoparalysis which had been almost absolute. One of the cases had improved so very rapidly after the change of diet that he had found it difficult to believe that the paralysis was the result of the pressure of an effusion. In none of his cases had there been bleeding from the gums. The absence of pain, fever, and fretfulness enabled one to differentiate between scorbutus and rickets. There might be some acute symptoms of rickets associated with the symptoms of scurvy. His cases had recovered very rapidly without any mechanical support.

Dr. Sayre said that he did not consider his case was one of pseudoparalysis. When pins were stuck in the foot the child made no effort to retract the foot, and when the limbs were lifted and then

let go, they fell in a lifeless manner. In comparatively few of his cases had there been bleeding of the gums. Some of his early cases he had diagnosticated as acute rickets, and he was not sure that the term acute rickets was not as good as scurvy.

Dr. Hoffmann said there was a reason for the spine being held in a position of kyphosis. In his case there had been great tenderness about the laminæ and posterior portions of the vertebræ, and the backward curve was probably an effort to separate these sensitive bony processes. The last dorsal and first lumbar vertebræ formed an angle almost as well marked as in Pott's disease. This, however, disappeared with the scorbutic condition.

Dr. McCurdy said that extreme distention of the bowel, due to fermentation, along with constipation, and the passage of grayish scybalous masses were additions that he would make to the symptomatology.

Dr. Taylor thought it unfortunate to confuse the two conditions of rickets and scurvy. Undoubtedly they might co-exist in the same case. He had noticed that in Dr. McCurdy's cases some of the children had rickets. Many of the reported cases had been absolutely free from rickets, and many writers beside himself had expressed their firm belief that the two diseases were absolutely distinct.

Dr. Ridlon said that he had completely forgotten Dr. Taylor's case; he thought he had in his mind all the papers that had been published in the Transactions. He had written to Dr. Northrup, asking him if he had ever heard of a scorbutic spine, and had received the reply that he never had. He had looked over the files of two or three pediatric journals without finding reference to this subject.

ANTERIOR SUPPORT SUPPLEMENTING THE TAYLOR BRACE IN THE TREATMENT OF POTT'S DISEASE.

By GEORGE B. PACKARD, M.D.,
DENVER.

The object of local treatment in Pott's disease is to stop motion at the point of disease, and to diminish, as much as possible, the intervertebral pressure.

The principal methods in vogue at the present time for fulfilling these indications are: the use of the antero-posterior splint, which embodies the principle of leverage, the jacket, made of plaster or other material, and recumbency.

These methods are all of great value, and each one has certain advantages, according to the stage, location, and symptoms present.

In the great majority of cases, except where recumbency is indicated for certain periods, the writer has generally preferred the antero-posterior splint, or what is generally known as the Taylor brace. And, it is worthy of note, that wherever a surgeon has had extensive experience with this principle of treatment he appreciates its great value and rarely abandons it for any other method.

This brace has the great advantage of adjustability, and it also allows inspection of the back at all times. It acts on the principle of a lever with the fulcrum at the diseased point; and with it we are able to diminish or increase pressure according to the indications.

In some locations we can produce a certain amount of lordosis, and thus reduce the pressure between the bodies of the vertebra to a minimum, and also hold the spinal column in the desired position. In order to accomplish this we have many obstacles to overcome in certain cases, and our success in treatment will be in proportion to our ability to overcome these difficulties.

In advocating this method of treatment I do not wish to reflect upon the plaster-jacket as a means of spinal support, for I think the application of the principles of treatment, as referred to, can be accomplished quite successfully with the plaster dressing—temporarily, at least, and permanently if reapplied at just the right time.

An objection to the jacket is that, while it fits accurately when first applied and serves the purpose admirably of holding the spine rigidly in the corrected position, it may very soon become loose from shrinkage of soft tissue, or cease to fit from other causes.

This becomes a serious matter if the patient lives at a distance and only makes visits to the surgeon at intervals of several months. Unless a new cast is applied immediately after the old one becomes inoperative, we are sure to lose ground in the treatment of our case.

Furthermore, they will not always report until they are reminded of their lack of support by certain symptoms which indicate progress of disease. Again, not being able to inspect the spine at short intervals, excoriations are apt to take place, particularly if there is any increase of the projection. These excoriations very materially interfere with thorough treatment.

If the corset is made removable for the purpose of inspection and cleanliness, it loses a great deal of its efficiency, and is therefore not advisable.

On the other hand, the jacket has certain advantages in some locations. Among them may be mentioned the more general distribution of pressure and support, particularly the rigid anterior support, which it furnishes; and were it not for the lack of adjustability it would frequently be the most satisfactory method of treatment.

Appliances to the spine for the treatment of Pott's disease ought to be removable, adjustable, and to remain constantly rigid.

In order to accomplish these objects, and also maintain as high a degree of efficiency as possible, it is important to retain all the advantages of the antero-posterior support, and at the same time not be deprived of the advantages of general support furnished by the plaster-jacket, particularly its anterior portion, which is an important part in making more perfect fixation.

I have used, with great satisfaction, an anterior rigid support in connection with the Taylor brace. The anterior support can be made of plaster, felt, or leather. It is simply a shell which covers

the anterior and lateral surfaces of the body; in other words, what would correspond to the anterior half of a plaster-corset.

This can be placed under the ordinary apron of a Taylor brace, and thus held in position. It will last a long time and retain its shape and rigidity, as the edges are not separated by its removal. The additional weight is scarcely noticeable. Dr. Taylor applies backward pressure under the clavicles. Drs. Lovett, Whitman, and Schapps have very forcibly called attention to the importance of anterior support and their methods of accomplishing it. But I have found the more general support, such as I have described, to more nearly fulfil the indications.

In the mid-dorsal region, where we are apt to get most deformity from the effect of the disease, and where it is also exaggerated by the compensatory curves above and below, the anterior support is of decided advantage. These anterior curves are more successfully combated by the rigid anterior support, extending from the pubes to the upper part of the chest. The sinking forward of the upper dorsal spine in these cases carries the ribs forward, and the chest becomes prominent and compressed laterally.

The anterior support which is distributed over the chest counteracts this deformity and helps to support the spine, through the pressure on the ribs, and if the cross-pieces of the back brace, to which the straps of the apron are buckled, are of sufficient length there will be no unpleasant lateral pressure.

The front piece can extend higher than the apron, and thus contribute materially to the efficiency of the brace in holding the upper portion of the trunk backward. It also more thoroughly combats the movements of respiration, which is important when the disease is located anywhere in the dorsal region. Of course, the anterior support would not supplant the head-rest, the latter being necessary in this location.

The lumbar spine can be held in contact with the uprights much better if there is a rigid support in front, and the anterior curvature, which really magnifies the posterior curve above, will be diminished.

In the lower dorsal and lumbar region lordosis is sometimes a troublesome feature and interferes with fixation. The anterior rigid shell supplementing the posterior uprights adds greatly to its efficiency in this location.

Briefly expressed, then, we have a support that is adjustable, removable, and rigid. We can inspect the spine at any time, regulating the pressure according to the indications, and at the same time have the additional anterior support which adds to the efficiency of the Taylor brace in many cases, and also retains many of the advantages of the plaster-jacket.

A SUSPENSION-PRESSURE CHAIR FOR ROTARY LATERAL CURVATURE OF THE SPINE.

By PHIL. HOFFMANN, M.D.,
ST. LOUIS.

KNOWING that excellent apparatus already exists for suspension-pressure correction of scoliosis, my only excuse for presenting this one is its simplicity and inexpensiveness, which permit it to be placed in the homes of patients, where the parent or nurse can be instructed in its use.

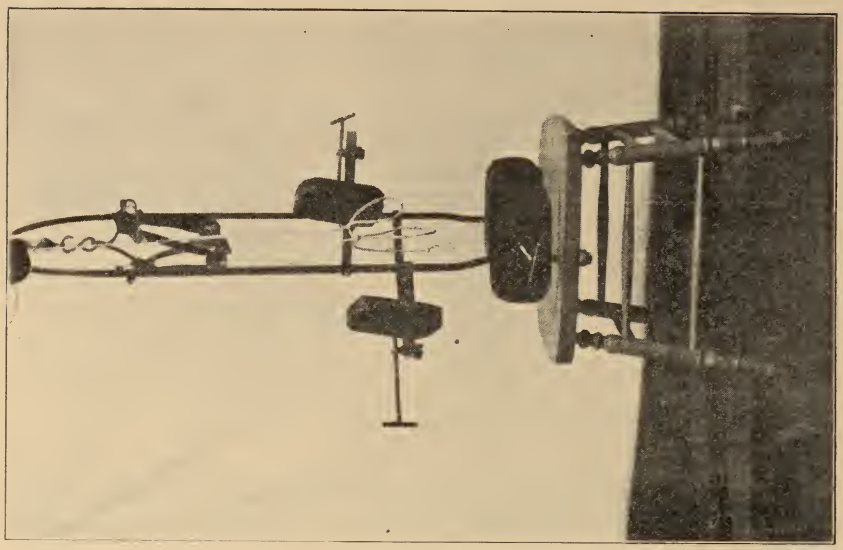
The apparatus consists of the pressure chair described by Bradford,[1] with the lateral steel bars prolonged upward to a height of four feet and a half, and meeting overhead to form an arch, to which is attached an ordinary suspension apparatus with compound pulleys. The semicircular steel bands can be raised to any height on the uprights, and the anterior and posterior pressure pads moved laterally upon the bands to correspond to the points on the chest and back where pressure is most desirable.

A detailed description is hardly necessary, as the photographs are self-explanatory.

When the patient has such an apparatus in his home he should use it two or three times daily, the time varying from ten to forty minutes, which, in the course of weeks, when summed up, will make many hours of direct corrective force applied to his deformed trunk. It should be used only as an accessory to proper gymnastic exercises and other treatment.

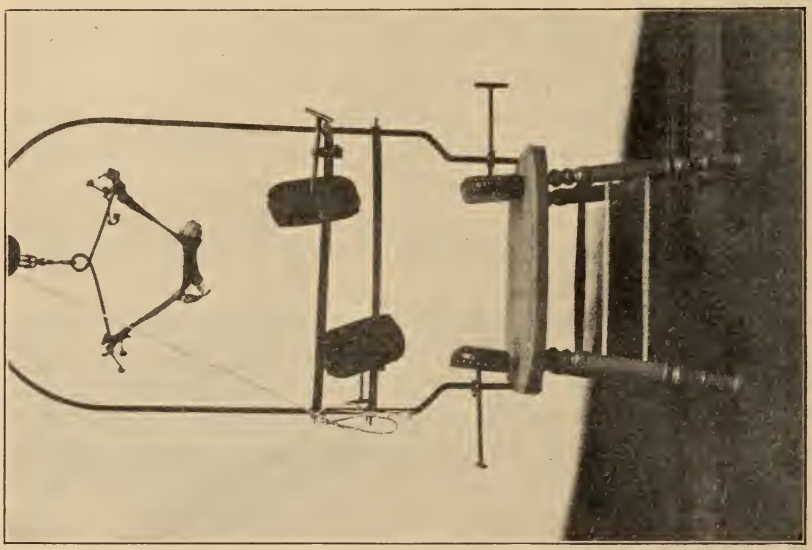
[1] TRANSACTIONS OF THE AMERICAN ORTHOPEDIC ASSOCIATION, 1891.

Fig. 2.



Chair. Side view.

Fig. 1.



Chair. Front view.

FIG. 3.

Patient showing lateral curve.

FIG. 4.

Same patient showing rotation.

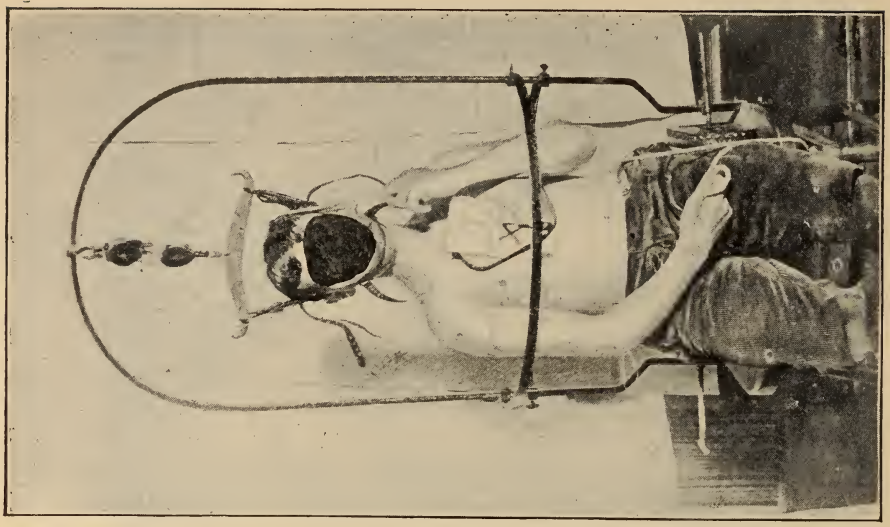


FIG. 6. Same patient in chair. Front view.

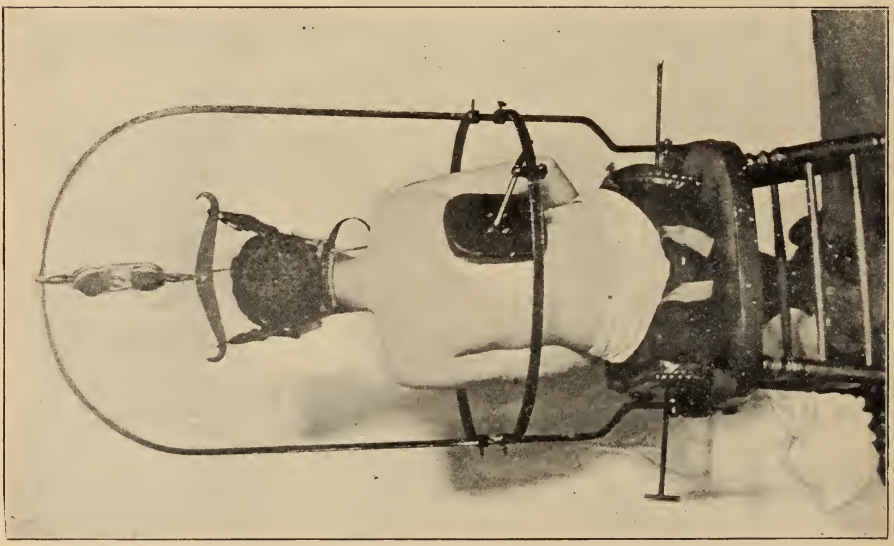


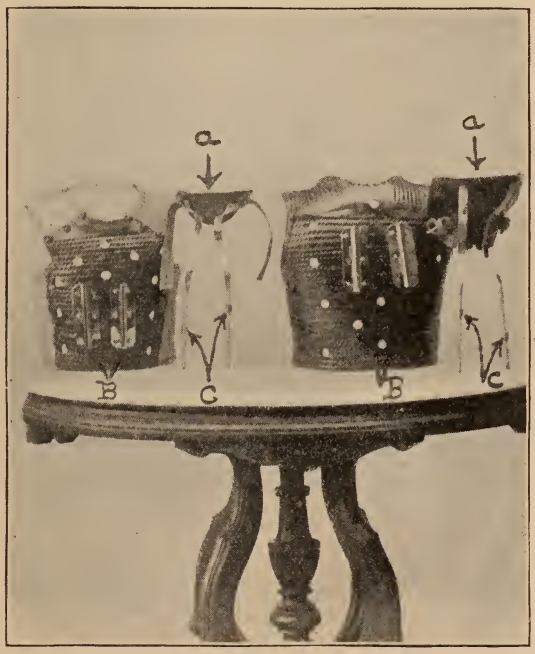
FIG. 5. Same patient in chair. Back view.

A NEW BRACE FOR CERVICAL SPONDYLITIS, WITH REMARKS ON CERVICAL BRACES IN GENERAL.

By PHIL. HOFFMANN, M.D.,
ST. LOUIS.

The ideal mechanical treatment for cervical spondylitis is the one that most successfully immobilizes the affected vertebræ, removes

Fig. 1.



Showing the four separate parts of the brace.

the superincumbent weight of the head, and relieves pressure between the inflamed surfaces. The one that best accomplishes these three

principles is, without doubt, recumbency combined with head-traction. It often happens, however, that the recumbent treatment cannot be applied, and that the surgeon is compelled to resort to a brace which permits locomotion.

Many different braces have been devised and are in use; but, so far as the writer has studied them, they may all be included

FIG. 2.

Front view.

in three classes: *a*. The indirect head-support from the pelvis, or jurymast; *b*, the direct head-support from the pelvis, and, *c*, the direct head-support from the shoulders, or the collar and cuirass.

a. *The jurymast* supports the head by means of a suspension apparatus attached to a body-brace, with its base of support at the pelvis.

The objections to this form of support are:

1. It is not direct, but through a circle, passing over the head and supporting it as in a swing.

2. It is not rigid, as it is in part made up of straps, requiring constant care and adjustment.

3. It allows motion of the cervical spine.

FIG. 3.

Back view.

4. The distance between the base of support and the head is too great.

5. It is apt to slip downward over the iliac crests and make the traction unreliable.

6. It is very unsightly, and immediately attracts attention when worn in public.

b. The direct head-support from the *pelvis* is attached to a body-brace with its base of support at the pelvis. The support reaches the chin and occiput directly without first passing over the head. For this reason it is better than the jurymast.

The objections are :

1. The distance between the base of support and the head is too great.

Fig. 4.

Side view.

2. It is liable to slip downward over the iliac crests.

c. The cuirass and *collar* support the head directly from the shoulders. They are not open to the same objections as the splints which have their fixed points at the pelvis.

The apparatus I wish to present belongs to the cuirass type with, however, a new principle. None of the braces already alluded to

provide for traction to be regulated on the patient, except, in a crude way, the jurymast, in which, by adjusting the suspension straps, the height of the chin and occipital pieces can be changed. In some braces the upright supporting the head-rest can be raised and lowered, but the purpose of this mechanism is to fix the support in a permanent position, and not for easy and daily regulation of traction when the patient is wearing the brace.

The writer's brace is shown in the photographs. The body part is of light sole-leather or skirting, and is composed of an anterior and a posterior half coming over the shoulders and lacing together in front. The chin and occipital cups are also made of hard leather. Two steel uprights in front and two behind, flat above and ending below in a screw with a fine thread, are riveted, respectively, to the chin and occipital cups, a a. The screw-ends play in snug-fitting tubes, B B, which are riveted by means of attached plates to the chest and back pieces of the cuirass.

After the brace is once in position the required amount of extension is made by means of nuts, C C, which play upon the screws. The lower the nuts are placed upon the screws the higher the head-pieces are carried. The chin and occipital cups are connected by straps under the ears.

Beside furnishing traction and relief from the superincumbent head-weight, the brace also serves to fix the contiguous dorsal vertebræ. In upper dorsal disease I would advise extending the cuirass to the pelvis, thus giving additional support from that point.

The leather work is shaped over a plaster-of-Paris cast of the parts by the method described by Dr. Steele.[1]

The photographs are good illustrations of the rigid support and excellent uplift afforded by the brace.

For poor patients the cost of the brace can be materially lessened by substituting plaster-of-Paris for the leather work.

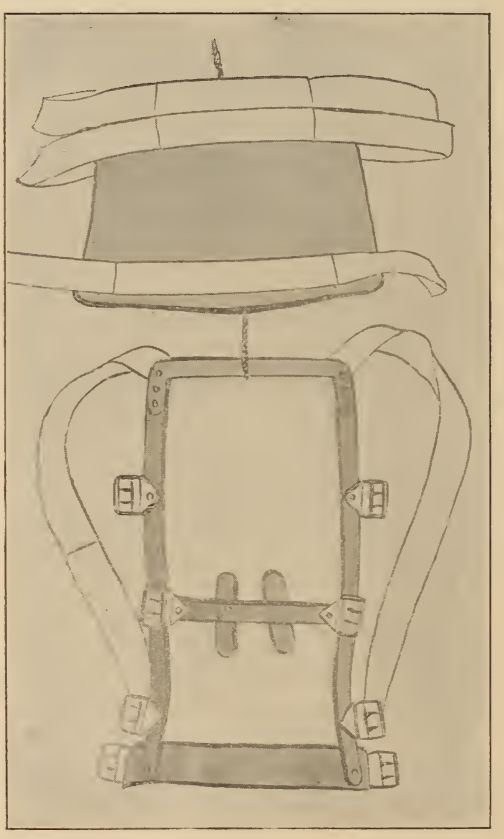
[1] Courier of Medicine, July, 1899.

A NEW BACK BRACE FOR POTT'S DISEASE.

By JOHN DANE, M.D.,
BOSTON.

The brace which is illustrated in the accompanying illustrations, represents an attempt to combine the antero-posterior support of the

Fig. 1.



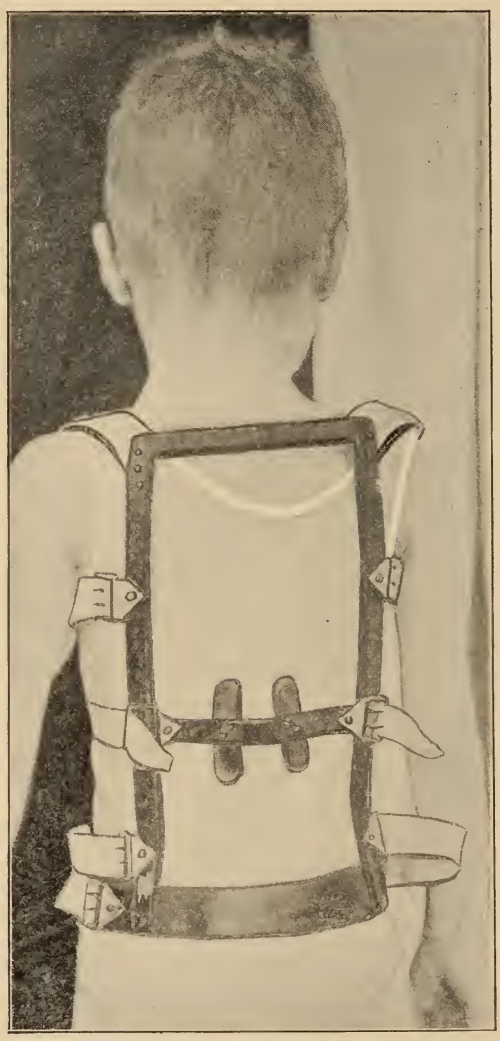
Taylor back brace with the protection against torsion that is furnished by the plaster-jacket. The lower part of the brace consists

FIG. 2.

of a light steel pelvic band, circling the back part of the pelvis, just above the trochanters. The two uprights, made of thin flat steel,

are fastened firmly to this at a point just outside of the posterior superior spines. They are joined across the top by a piece of similar

Fig. 3.



material, making the brace as wide as possible across the shoulders. The pad plates are riveted to a separate bar of steel that is fastened to the upright by means of a flat-headed screw. The opening for

this screw upon the cross-bar is made in the form of a slot to allow for variations made in adjustment. The iron work, which is sufficiently light to be easily bent by wrenches, is faced on the side next to the patient with leather. Counter-pressure is obtained by an abdominal belt of rather thick leather, to which webbing straps are sewn; and padded straps are used to pull the shoulders back against the brace at its upper part. Ordinary buckles are riveted firmly to the brace. There is neither apron nor straps encircling the chest above the diaphragm. While acting as a lever-brace, by means of its pad plates, which press firmly against the transverse processes of the kyphos—the great width of the brace gives it the advantage of a frame or cradle into which the patient is strapped. A firmer support for the whole thorax is thus obtained.

In disease of the lumbar regions this is very inportant in checking movements of rotation, and in the dorsal regions in restraining movements of the ribs. From the absence of central uprights, it is impossible to make pressure with this brace upon the spine above the disease, while the ease of adjusting the pad plates is greatly increased by making the bar which carries them completely and easily detachable. The absence of any pressure over the chest greatly increases the ease of breathing, while the height and width of the brace at the top permit an excellent control of the shoulder girdle without contraction of the chest. Lastly, the simplicity of these braces reduces their cost to less than one-half that of the ordinary Taylor brace. The actual cost of its manufacture is between four and five dollars.

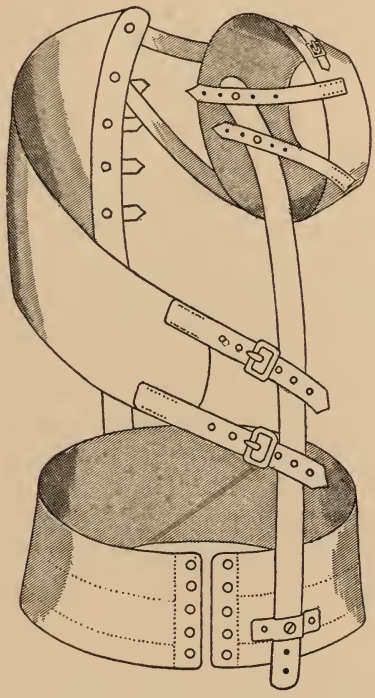
A BRACE FOR LATERAL CURVATURE OF THE SPINE.

By GWILYM G. DAVIS, M.D.,
PHILADELPHIA.

In many cases of lateral curvature of the spine in addition to the purely lateral deformity there is an antero-posterior deformity with a drooping of the shoulder and a rounded projection of the upper portion of the back. This is best treated by a brace similar to the one I exhibited before the Association last year, in which direct backward pressure is made on one or both shoulders from the front. In other cases, however, the deformity is not so marked, and there is mainly a lateral deviation, the back being fairly straight. It is in such cases that the brace here described is of service. It consists of a waistband bearing two uprights, to the upper ends of which is attached a leather band encircling the shoulder of the low side. From the upper portion of the posterior upright a broad canvas band passes over the hump under the axilla, to be fastened low down in front to the anterior upright.

The waistband is made of sufficiently pliable metal to be accurately fitted to the contour of the hips between the greater trochanter and the crest of the ilium. It is to be so stiff as not to be distorted by the twisting action of the brace. The anterior upright is fastened to the waistband just to the inner side of the anterior superior spine of the ilium of the low side. It passes up in front of the side of the chest, and at its upper portion it inclines a little inward. The posterior upright passes up either the median line of the back or a little to the outer side over the projecting hump. On the low side a leather band encircles the shoulder. Its upper part is opened and fastened with a strap. Its lower portion where it passes under the axilla is padded. This is suspended from the top of the two uprights. A broad canvas band passes from the upper portion of the posterior

upright over the hump, under the axilla and across the lower portion of the chest, to be fastened by two straps and buckles to the anterior upright, well down toward the waistband. The brace being applied, the low shoulder is supported by the leather band encircling it. On tightening the canvas band pressure is made on the hump, while counter-pressure is made on the opposite side by the waistband below and the armband above. A rotary action tending to



Brace for lateral curvature of the spine.

counteract the distortion is also exerted. This will be made evident should the waistband be made too light when the whole brace tends to shift itself around.

It is not a brace suitable for all cases, particularly those which are very marked, but in certain selected ones it is very efficacious. It is quite light and does not confine the body much. This is a distinct advantage in warm weather. It is also quite durable and comparatively easily kept in order. It is best adapted to the less severe

cases in which the back is comparatively free from antero-posterior bending. Of course, it is intended only as a support in the intervals of exercising, and must be removed when these are performed.

DISCUSSION.

Dr. R. H. Sayre, of New York, thought the principle involved in this instrument was wrong. We were going back to the same things which were spoken of as long ago as the meeting in Philadelphia in 1890. Dr. Lovett's paper and the discussion thereon explained the principle thoroughly. If pressure were made on the large side, as it would be when the brace just presented was used, the peak of this arch would become more and more arched. The force would be directed so as to transfer the leverage in such a way as to turn the vertebræ around on their axes in the wrong direction. All forms of apparatus which make pressure on the side most distant from the spine simply serve to increase this bulging.

Dr. L. A. Weigel, of Rochester, N. Y., thought there was another valid criticism on such a brace. If he understood the principle of treatment correctly, it was necessary to get a base of support at fixed points. The shoulder girdle was not a fixed point of support, being entirely independent of the skeleton proper, and is not attached to the spinal column. Therefore, simply keeping the high shoulder down could not have any special corrective influence on the deformity.

Dr. Davis, in reply, said that the brace was not intended to make only lateral pressure. The brace was made of strong, firm material, so that the pelvic girdle would not twist; hence, he was of the opinion that it did not exert merely a direct lateral pressure, but in addition a twisting force. Of course, if the pressure were directed backward it would tend to increase the curvature, but as in this apparatus the straps were fastened in front, the tendency of the apparatus was to draw the hump forward. As to the question of support, he would say this was merely a question of adjustment. The uprights were made so high that the low shoulder was practically swung from the top of the anterior and posterior rods.

RETARDATION OF GROWTH AS A CAUSE OF SHORTENING AFTER COXITIS.

By HENRY LING TAYLOR, M.D.,
NEW YORK.

The muscular wasting, so constant in the early stage of hip disease, appears to be hastened and increased by immobilization, compression, and suspension of the affected limb. After months or years of pathological or mechanical interference with function the limb is finally much shrunken, not only in its muscular elements, but in all its tissues, including the bones, whose growth has not kept pace with that of the well limb either in extent or structure; they are finally smaller, shorter, and more brittle.

While the wasted muscles always seem capable of development, after the subsidence of inflammation, within the limits imposed by joint function, one cannot fail to be struck by the superficial resemblance between the shrunken appearance and bluish, clammy, surface of many of these bandaged and restricted limbs and the atrophied limbs following infantile paralysis. This similarity extends in a remarkable degree to the retardation in growth, both longitudinal and circumferential, of the long bones of the affected member.

The writer's attention was rather forcibly called to the importance of retarded growth after coxitis by the case of a boy of fifteen years, who returned, in 1891, after several years' absence; during the last two he had not worn any apparatus and had remained free from disease. He had grown rapidly and was in excellent health, but complained that his leg had grown shorter. On measuring the lower limbs, it was found, to the writer's surprise and chagrin, that the shortening had increased from a trifle over an inch in 1887 to four

and one-half inches four years later. This led to separate measurements of the femora and tibiæ, which disclosed a shortening of two inches in the femur and of one and three-quarter inch in the tibia of the affected side. The remainder of the shortening was doubtless due to upward displacement of the femur, but here were over two and a half inches loss of growth in four years.

This incident made a deep impression and led to comparative measurements from time to time of the long bones of the limbs after coxitis, and occasionally after other affections. It soon became evident that differences of one inch in the length of the tibia and of one-half inch or more in the foot in old cases of coxitis were not at all uncommon. Within the last two months these measurements have been repeated in a series of cases of coxitis, and also in other disabling affections of one limb, to see if any generalization was warranted. Since the principal object of the investigation was to ascertain the length of the shaft of the long bones on the two sides, the femur was measured from the tip of the trochanter to the knee in the hip cases, to eliminate erosion, displacement and bending of the neck, which do not directly concern this study. Measurements of the length of the tibia, of the length of the foot, and of the breadth of the patella were also taken.

The results in thirty-seven cases of coxitis may be seen in the table, which is divided into three sections, according to the duration of the disease; the approximate averages are given for each group.

TABLE.—SHORTENING IN INCHES AFTER COXITIS.

Case.	Sex.	Age.	Disease.	Duration. Lameness.	Duration. Treatment.	Abscess.	Shortening. Limb.	Shortening. Femur.	Shortening. Tibia.	Shortening. Foot.	Shortening. Patella.	
							inc.	inc.	inc.	inc.	inc.	
1	F.	3½	L. hip	1	1	No	½	...	¼	3/8	1/8	
2	M.	7	R. "	1½	1	No	¼		¼	3/8	1/8	
3	M.	5	L. "	2	1	No	1/8	¼	¼	1/8	1/8	Left femur longer.
4	M.	5	R. "	2	1½	No	3/8	...	¼	...	1/8	
5	M.	6½	L. "	2½	1½	Yes	¾	¼	3/8	3/8	¼	
6	F.	9	L. "	2½	2	No	¼	...	1/8	¼	1/8	Left limb longer, coxa valga?
7	F.	4½	L. "	3	3	No	.	...	...	...	¼	Scarlatinal.
8	F.	6½	R. "	3	none	No	½	...	¼	...	...	No treatment; always walked [on leg.
9	M.	6	R. "	3	2½	No	1 3/8	¼	¼	½	3/8	
10	F.	13	L. "	3½	2	No	¾	...	5/8	1/8	1/8	
11	F.	7	L. "	3½	3½	No	1 3/8	½	¾	⅞	¼	
12	M.	7	R. "	3½	3½	Yes	1	¼	¾	¾	3/8	
13	F.	11	R. "	3½	1½	No	1¾	¼	5/8	¼	1/8	Forcible correction.
14	F.	9	L. "	3½	3½	No	1½	...	½	½	1/8	
Average		7		2½	2		¾	⅛	3/8	¼	⅛	
15	M.	7	R. hip	4	3	Yes	¾	...	⅛	¼	¼	
16	M.	7	R. "	4	4	No	1	¾	¼	¾	½	Fracture; forcible correction.
17	F.	8½	R. "	4	4	No	1	¼	½	¼	3/8	
18	F.	12	R. "	5	4	Yes	3¼	½	1¼	5/8		
19	F.	11	R. "	5½	4	Yes	2¾	1	½	¼	½	
20	F.	13	L. "	6	3	No	2	½	1 3/8	½	¼	
21	F.	10	L. "	6½	4	No	1¼	¼	¼	...	¼	Left off brace 2½ years ago; [relapse.
22	F.	10	R. "	7	7	Yes	1¾	½	⅞	¾	3/8	
23	M.	14	L. "	7		Yes	2½		¾	¾	¼	
24	F.	15	R. "	7	5	No	2¾		1	½		
25	M.	9½	R. "	7	½	Yes	1¼	...	½	¼		
Average		11½		6	4		1¾	½	5/8	3/8	3/8	
26	F.	13	R. hip	8	7	Yes	2½	¼	1½	1	¼	Forcible correction.
27	M.	15	R. "	9	6	Yes	4½	2	1¾			
28	M.	10½	L. "	9		No	1½	½	⅛	¼	½	
29	F.	18	R. "	9	7	No	2¾	4	1	½	¼	
30	M.	12	L. "	10	2	No	1¾	¾	...	...	¼	
31	M.	18	R. "	11	10	Yes	2	¼	1	5/8		
32	F.	15	L. "	11	7	Yes	3	¼	⅞	¼	3/8	
33	F.	15	R. "	11	5	Yes	1	¼	¼	½	¼	No treatment last six years.
34	F.	15	R. "	11½	9½	Yes	3	¾	¾	½	½	[ment before.
35	F.	16	L. "	14	1	No	1½	¾	¾	½	½	May, 1899, Gant's. No treat-
36	F.	21	L. "	17	6	Yes	5½	2½	2½	¾	¼	Caries lumbar spine. Gant's, [1891.
Average		15		11	6		2⅝	⅞	1	½	3/8	
37	F.	40	L. hip	40	37	No	3	1½	½	¼	⅛	

... signifies that the measurements on the two sides were equal.
A blank signifies that the measurement was not taken.

The results may be briefly summarized as follows:

Femur. In twenty-three cases the shaft of the femur of the affected side was from one-quarter to two and a half inches shorter than that of the well side. In nine cases there was no demonstrable difference, and in one case the femur was about one-quarter of an inch longer. The shaft of the affected femur was often very much thinner to palpation, and the condyle much narrower and smaller. In four cases the femur was not measured.

Tibia In thirty-five cases the tibia was from one-eighth to two and a half inches shorter on the affected side; in two cases there was no difference.

In twenty cases the shortening of the tibia exceeded that of the femur; in seven cases the two were equal, and in six the shortening of the femur was the greater.

Fibula. In a number of cases in which the fibula was measured, it showed about the same amount of shortening as the tibia.

Patella. The patella of the affected side was nearly always smaller and narrower; in many cases its bulk seemed to be less than half that of the well side. Twenty-six cases showed a difference of from one eighth to one-half of an inch in transverse diameter, usually about one-quarter of an inch. In one measured case only was no difference found; this patient had walked freely and had never worn a brace.

Foot. In thirty-one cases the foot was from one-eighth to one inch shorter, and often distinctly smaller in other dimensions. In five cases no difference in length was noted.

If the cases are divided into three groups, according to the length of time which had elapsed from the beginning of the disease to the date of the last measurement, the total shortening, as well as the shortening of the individual long bones and of the foot, and the narrowing of the patella, are found to increase progressively with the duration of the lameness.

In some instances cases of long standing which had had but little mechanical treatment show less shortening, though there might be deformity and relapse, than cases of equal duration where mechanical treatment had been prolonged. After forcible correction of the deformity retardation of growth was exaggerated, though the cases are too few to generalize.

In some cases retardation was much above the average, and in others much below, from unknown causes.

Infantile Paralysis. In the third group of hip cases, with an average age of fifteen and an average duration of eleven years, the average bone shortening was slightly under seven-eighths of an inch in the femur and slightly under one inch in the tibia, or about one and three-quarter inch total. This group may be compared with a group of ten cases of unilateral infantile paralysis with an average age of thirteen years and an average duration of lameness of eleven years, where the average shortening was about one and three-quarter inch, and in no case over two and a half inches.

While the condition of the muscles in the atrophied legs after poliomyelitis is pathologically different, the fact that the longitudinal growth of bones seems to be no more retarded after paralysis than after coxitis, and that in both the affected limb is used very imperfectly, if at all, in support and locomotion, suggests that interference with the normal function of the limb may be an important factor in the retardation of skeletal growth. This inference is strengthened by the consideration that just as we may produce a partial paresis of the circulation by bandaging and suspending a limb, so we may cause such a condition to disappear in certain paralytic cases by bringing a useless limb into action.

Infantile Hemiplegia. Many cases of infantile hemiplegia of long standing show a certain retardation of growth of the long bones of the affected side, though usually less than in poliomyelitis. It is to be noted that the leg is used more in walking than in infantile paralysis.

Congenital Dislocation of the Hip. In ten cases of unilateral congenital dislocation of the hip from four to thirteen years of age the total shortening measured from the anterior iliac spine varied from one-half to two and one-quarter inches, but the femur was shorter (one-quarter inch) in only one case and the tibia (one-eighth to one-half inch) in five. The foot was one-half to five-eighths inch shorter in the older cases, and the patella was slightly narrower in six cases

Here also we are to note that locomotion is constantly practised.

Hip Excision. One case of excision of the head of the femur, at two years, showed no difference in any of the bone lengths at five

years, though there was upward displacement of one inch. It is the writer's impression, however, that the considerable shortening after hip excision in children will be found to be partly due to retarded growth, after as well as before the operation. After knee excision in children this shortening has been shown to be a progressive and most serious factor, owing, as has been supposed, to interference with the epiphysis.

Fracture of Neck of Femur and Coxa Vara. No opportunity for measuring cases of fractured neck of the femur in children has recently presented itself. Dr. Whitman reports increasing shortening, which he attributes to change in the angle of the neck. It is possible that these cases and those of coxa vara occurring in the period of rapid growth may show some retardation on the affected side, but since the limb gets a fair amount of use, the retardation, as in the congenital hip dislocations, would probably be small and occasional only.

Osteitis of the Knee. Of nine cases measured, aged from three and a half to thirty-three years, six had a duration of lameness under five years. All these showed lengthening of the affected limb ranging from one-eighth to seven-eighths inch. The three older cases showed shortening from one to two and a half inches. In the first group the femur was longer in four from one-quarter to three-quarter inch. The tibia was longer in two, equal in two, and shorter in two. In the second group the tibia was one-half to two and three-quarter inches shorter. In seven cases the affected foot was shorter one-eighth to one and one-quarter inch, and in all the affected patella was one-eighth to five-eighths inch narrower.

Here the proximity of the inflammation to the principal epiphysis for growth modifies the result. There is for a time acceleration of growth in length near the focus, but this goes hand in hand with retarded growth of the patella and foot and of the leg bone unaffected by the irritation. The primary acceleration is followed by a later retardation from disuse, which usually more than counterbalances it.

Congenital Defects of one Lower Limb. The type of congenital defect of a limb, characterized by imperfectly developed or absent long bones, especially of the fibula, and certain bones of the fibular side of the foot, shows a progressive retardation of growth. Here

the tibia or femur or both may be the fraction of an inch shorter in early infancy, but the limb is little, if at all, serviceable for locomotion, and falls behind its mate in growth until at fourteen or fifteen years the difference often amounts to several inches. Cases of congenital pes equino-varus will sometimes show considerable differences in the length of the limbs, tibia, and foot, and breadth of patella, after the lapse of some years.

In considering these results it should be remembered that not only is the affected limb under-developed in all the instances given, but that the sound limb may be over-developed, since it does far more than half, and often more than the normal amount of work, as is plainly evident from its circumferences. It is not impossible, though difficult to prove, that not only is the affected limb shorter than normal, but the sound limb may be longer as well as stronger than normal. If so, this would exaggerate the difference between the two sides, and tend to make one over-estimate the amount of retardation.

While there may be a primary neural factor in certain classes of growth retardation, and while disuse may produce its effect in part through the nerve centres, the writer is inclined, from a study of the facts here presented, to attribute to fixation, compression, and suspension of the affected limb, and to faulty or absent locomotion, an important rôle in growth retardation.

If this inference is correct, while one should not hesitate to make necessary sacrifices in order to promote the comfort of the patient, combat deformity, and eliminate disease, it is not a matter of indifference how long the use of the limb is restricted. Protected locomotion, permitting joint and muscle action, with a minimum of strain and pressure, would seem to be indicated in the stage of convalescence from joint disease. That method of treatment, operative or mechanical, should evidently be selected which will give the best functional result with the least restriction.

A rather hasty search has revealed but few references to this topic in medical literature. Hüter makes some general observations on retarded growth of a limb after coxitis in his work on *Joint Diseases*, published (second edition) in 1877. An excellent study, by Dr. Russell A. Hibbs, of shortening of the tibia and femur in fifty cases of tuberculous disease of the hip-joint, published in the *New York*

Medical Journal, December 16, 1899, shows results similar to those here given.

Quite unexpectedly to the writer, and to some extent contrary to his preconceptions, this study, so far as it goes, appears to justify the following conclusions:

1. Considerable retardation of growth, both in the length and thickness of the limb and its component bones, is the rule after coxitis and other affections causing long periods of lameness or disability in childhood.

2. The amount of retardation appears to bear a distinct relation to the amount and duration of the restraint or disability.

3. This inhibitory effect of restraint should be considered in selecting treatment for disabling affections of the lower limbs. Other things being equal, locomotion is desirable, and restraint for long periods harmful, though complete or partial interference with function must often be enforced as the least of evils.

DEVELOPMENTAL SHORTENING IN TUBERCULAR BONE DISEASE.

By STEWART LeROY McCURDY, M.D.,
PITTSBURG.

The cases herewith reported are filed as evidence to further emphasize the statement which has already been made, that during an active tubercular disease the bones thus affected do not keep pace in growth and development with their healthy fellow.

The principal element, as recorded by text-books, producing shortening is given as a destruction of the nutrient vessels supplying the epiphysis and approximal portion of the shaft. In hip shortening the cause is given as the destruction of the head or neck of the femur or of the superior rim of the acetabulum permitting spontaneous displacement. Some text-books also mention non-development as a possible factor in accounting for the difference in size of the two extremities. Indeed, all surgeons who see old cases of tubercular disease recognize this difference in size, which is not only shown in the length of the member, but in circumference as well.

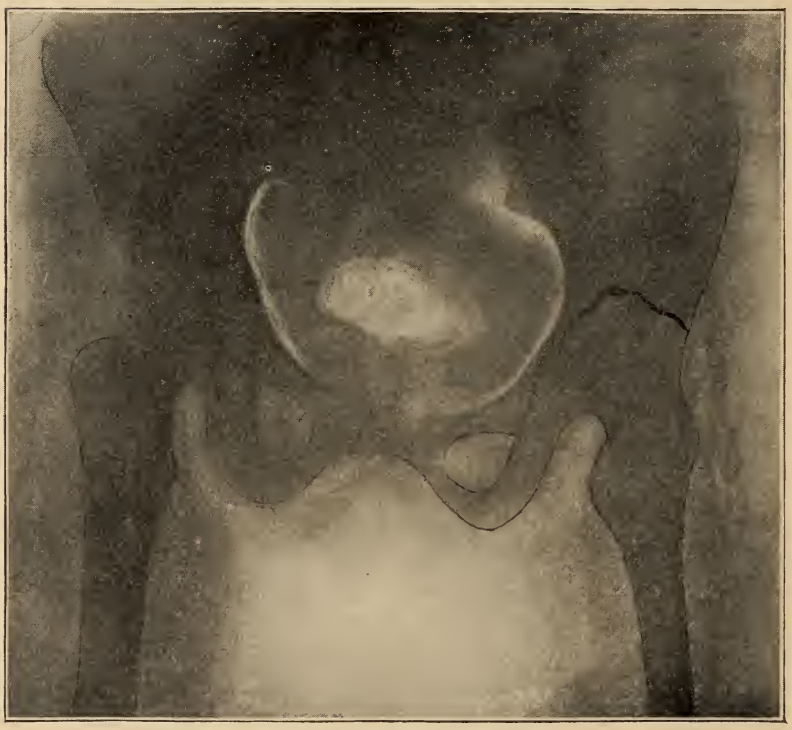
The atrophy so constant and seen so early in all of these cases, is, as a rule, attributed to trophic changes in the muscle alone. While early atrophy must necessarily be of the muscles and soft structures, we must conclude that there is a corresponding impairment of the growth of the bone, since nutrition to all of these structures is presided over by the same sympathetic nerves to all structures of an extremity.

The first case is that of a patient aged twelve years, who has had hip disease for about six years. Eighteen months after the onset of the disease a diagnosis was made, and treatment instituted. The case has gone through abscess which, however, did not erupt or require aspiration, but disappeared under massage and local absorbents.

The patient has not had an active symptom for one year. There is by measurement actual shortening of two and a half inches.

The radiograph taken since active symptoms have disappeared is interesting, since it permits a comparison of the two joints and femora. The contrast is quite apparent. In the right every line is perfectly uniform. There can be seen a light line about the head of

FIG. 1.



the femur outlining the normal curve. The diaphyso-epiphyseal line through the femur is shown, as is the line of non-ossification between the ilium and pubis leading from the acetabulum to the cavity of the pelvis.

The left femur, it will be observed, is much smaller than the right in the shaft, as well as about the trochanters. The joint is not outlined, as is shown in the right, but instead there is an irregular line

showing a disorganization. The lesser trochanter is more prominent, and the angle of the neck is less acute; but these things are due to

FIG. 2.

the outward rotation of the femur. When we recall that during the process of tubercular disease of long bones the entire growth of the

bone is interfered with, as is shown in this case, there must necessarily result more or less shortening, even if that shortening is not due to the destruction of the bone at the articular surface.

The second specimen is the long bone of the right leg of a young man, aged twenty-two years, which was the size of the leg of a boy twelve to fifteen years, dislocated and shortened, as can be seen from the specimen. A comparative measurement of the two

FIG. 3. FIG. 4.

bones of the amputated leg and the healthy leg shows that the femur of the latter is one inch longer, and the tibia and fibula one-half inch longer, or a total of one and a half inch of developmental shortening.

The specimen shows that that part of the femur which rested over the acetabulum was three inches below the apex of the greater trochanter, or the point indicating the centre of the acetabulum. While

a circumferential measurement of the extremities was not made previous to amputation, there was a very apparent difference.

Another case, shown in Fig. 3, is that of a girl who had gone through hip-joint disease without special treatment, and recovered with extensive adduction and flexion, requiring a Gant osteotomy, with a result as shown in Fig. 3. One year after this operation a subluxation of the knee, as shown in Fig. 4, developed, without active symptoms of any kind, yet there developed in addition to the femur one-half inch shortening of the tibia, which can be accounted for only by assuming that the growth of the entire extremity is controlled by the same sympathetic nerve.

DISCUSSION.

Dr. R. H. Sayre, of New York, said he did not think there could be any question but that exercise increases not only the growth of the soft parts but of the bones. In reports from the gymnasiums of our colleges regarding young men who had passed, for the most part, the age of nineteen or twenty were quite surprising. This was particularly true of the reports from Amherst College, which showed that the bones as well as the muscles increased. The speaker said that he had noticed in cases in which apparatus had been discarded from one limb a considerable time before the other, when both were affected, the increase of growth in the limb first liberated was very noticeable. All of the small bones of the feet, as well as those more directly connected with the diseased area, were affected in this way. He had in mind one case of double hip disease in which the patient had been prevented from walking for a long time. On one side there had been extensive suppuration, involvement of the acetabulum, and perforation into the rectum, with the discharge of feces from the buttock. Subsequently the other side had been involved, but had not suppurated. Although there had not been more exercise on one side than on the other, the side on which the suppuration had occurred was much more shortened than the other limb, in which the disease had existed for practically the same length of time. With regard to the skiagraph presented, it showed very nicely the destructive process in the acetabulum and head of the femur. He

would call attention to the fact that some of the diminution in size of the bones seen in these skiagraphs was partly due to the fact that the bone being atrophied on that side, the part came more nearly in contact with the photographic plate, and, hence, the shadow was smaller. A very slight diminution in this distance made a considerable difference in the size of the shadow, because it varied with the square of the distance.

Dr. Joel E. Goldthwait, of Boston, said he had measured, a few years ago, very carefully a series of hip-joint cases under treatment at the Children's Hospital, in which hyperextension of the knee was prominent. In practically all of these cases the shortening had taken place below the knee. The skiagraphs from these cases showed a perfectly regular atrophy or lack of development of the upper end of the tibia. The epiphysis, instead of being square in front, was wedge-shaped, and there was also a marked depression at the epiphyseal line. He had no explanation to offer, and merely stated it as an interesting fact in connection with these observations.

Dr. Louis K. Weigel, of Rochester, said that last year he had shown some lantern slides of some old hip cases, and in these atrophy not only of the femur but of one side of the pelvis had been clearly demonstrated. The point raised by Dr. Goldthwait was one which he had intended to bring up later, especially with reference to the influence of weight-bearing on the growth and shape of the bone. In his opinion there was no question about this being a very important factor.

Dr. V. P. Gibney, of New York, said he had often wondered whether any data were accessible in the early stage of hip disease, for instance, by means of which one could prognosticate for a given patient a minimum or a maximum of shortening. Most orthopedic surgeons were chagrined at times to find, after the best efforts at treatment and management, that the limb showed so much shortening in cases of four or five years' duration. He had seen cases go without shortening for several years, and then quite rapidly develop half an inch to three-quarters of an inch shortening a year without evidence of any symptoms of a new or an acute process.

The question was of much more importance from the stand-point of prognosis. The tendency was to give a somewhat too favorable prognosis. Comparing the hip with the knee it seemed to him that there should be elongation of the femur in hip disease as well as in disease of the knee. Most of the investigations show that in tuberculous disease of the knee the limb actually lengthens, and he was himself so thoroughly convinced of this that he did not hesitate to state to the parents that ultimately there would not be any shortening, but probably an increase of from half to three-quarters of an inch in length. He had explained this sometimes by saying that the disease in the epiphysis excites this overgrowth. If this were the true explanation he could not see why, with the efficient traction splints at our disposal, the upper epiphysis should not grow also, and why when there is not complete destruction of the epiphysis there should not be elongation. According to his experience, in some of those dry cases which go on so well at first, often show after a few years an alarming degree of shortening. Personally, he was unable to tell whether the limb which was excised subperiosteally would continue to grow at the same rate as the other limb if the patient continued to use it; perhaps Dr. Sayre could give some information on this point.

Dr. H. A. Wilson, of Philadelphia, said that the recent observations of a medical missionary to China seemed to show that shortening was due to disuse and compression. This lady's observations had been on the bound feet of Chinese women. She had observed that after the usefulness of the muscles had been partially restored there had been evidence of increase in the diameter and length of the bones. These observations had not been based on actual statistics, but on casual observations extending over a considerable time. If they were accurate, it would appear as though very much of the shortening observed in cases of joint inflammation were not due so much to the joint inflammation as to the bandaging and interference with the circulation.

Dr. A. M. Phelps, of New York, asked why it was that in bone disease one saw a rapid atrophy of the limb, whereas this would not occur or would be very slight in disease of the soft parts? In a

case of synovitis two or three months might elapse before any considerable shrinkage of the muscles would be noticed, whereas in disease of the bone, atrophy would be noted in two or three weeks He had come to the conclusion that the shrinkage of the muscles was due largely to a neurotic influence—that it was a true degeneration of the muscles due to the reflexes. The pressure of terminal end plates is very much greater in bone than in the soft parts, because in the latter the parts could distend. The growth of the femur takes place from the lower end. In cases of excision in children it would be found that a little shortening takes place in the course of a few years, and this shortening is in the neck. Again, the circulation in the bone was carried on by the pressure of the muscles which force the blood into the bones; hence, if the limb were placed at rest the circulation would be impaired and the bone would undergo atrophy. This explained why in many cases of excision the bone would be found to have undergone fatty degeneration or atrophy. In cases of osteomyelitis, particularly of the tibia, observed for years, it would be found that there was a constant stimulation of the parts by the presence of sequestra, and, as a result, there would be an increase in the length. One case was recalled in which the tibia was four inches longer than it had been fifteen or twenty years before. Nutrition was diminished by placing the parts at rest, and this, together with the neurotic influences from the reflexes, explained to his mind the shrinkage of the muscles and of the bone.

Dr. H. P. H. Galloway, of Toronto, said that one reason why in knee-joint disease the limbs become lengthened was that two epiphyses were subjected to stimulation—the lower end of the femur and the upper end of the tibia. In the upper epiphysis of the femur the increase in length was confined to the neck, which is placed obliquely to the shaft of the bone, and, consequently, this exerted comparatively little influence in the way of increasing the length of the femur as a whole.

Dr. N. M. Shaffer, of New York, said that he had given much attention to the neurotic influence touched upon by Dr. Phelps. He had kept a record of many cases, with the idea of determining

the amount of shortening that occurred as a result of the disease. In cases in which the nervous phenomena had been most marked—especially in the dry cases—the shortening had been proportionately larger than those even in which suppuration had been present. For this reason, in giving a prognosis as to the shortening, he studied the nervous symptoms especially, and looked for more shortening in those cases in which the reflex spasm was most marked. He had recently written an article on "The Nervous Phenomena in Joint Disease," and had here elaborated this subject more fully. His explanation was that the epiphysis, being a local nutritive centre and being amply supplied with nerves from three great nerve centres, was one which was accompanied by the very reflex phenomena referred to by Dr. Phelps. On the other hand, the synovial membrane was sparsely supplied with nerves, and being easily distensible no nervous phenomena arise from that source until very late in the disease. The reflex nervous phenomena, therefore, from the clinical stand-point, bear a close relation to the amount of subsequent shortening.

Dr. John Ridlon, of Chicago, said that muscular shrinkage with evidence of reflex spasm was not always present, as had been assumed by everyone, so far as he knew. Most of those present had noticed a rather heavily built man standing on crutches. This gentleman had had hip symptoms for four years before the diagnosis had been made by Dr. Packard, and his brother had tuberculosis of the lungs. From the time he had first been seen by Dr. Ridlon in September, some years ago, until the following June, he had not been able to sleep on an ordinary spring-bed so intense had been the reflex spasm. The head and neck of the bone had been almost completely destroyed, as shown by the X-rays, yet the limb had never been as small as the well one. Here was an exception occurring in a case which had exhibited the most intense reflex spasm.

Dr. Weigel said that last year he had shown a skiagraph of the tubercular wrist of a child in whom the development of the carpal bones on the diseased side was at least one year in advance of the normal, and this was probably due to the congestion incident to the tubercular process.

Dr. Sayre asked Dr. Ridlon if the skiagraph had shown the muscles to be fatty. He had seen a case in which nine inches of femur had been removed by excision, yet there had been only four inches of shortening. Another case had had four inches removed, yet there had been only one-quarter of an inch shortening. In many other cases subperiosteal excision had not been followed by subsequent diminution.

Dr. Taylor said that Dr. Hibbs had brought out in his paper that lengthening in the very early stages of hip-joint disease could be detected in many instances by taking the measurement from the anterior superior spine to the knee-joint. The measurement that he had taken had been from the trochanter, and, consequently, the lengthening of the neck did not show in his cases. Careful measurements from the anterior superior spine to the knee-joint would probably show lengthening in certain of the early cases. This lengthening, however, was trivial in comparison with the lengthening at the knee-joint. He was not able to distinguish in the early cases between those which would be followed by considerable shortening and those which would not, but he had never had the boldness to say that any case of hip disease would not be followed by shortening. The principal fact which he submitted in the paper was that the average shortening in all of the bones of the lower extremity following hip disease of many years' standing was almost the same as the shortening which follows infantile paralysis of the same duration. This, to him, was a very striking and surprising fact. He fully agreed with those who attributed this retardation of growth and lack of development to circulatory disturbance. These came in part through nervous influences, and in part from mechanical compression and disuse.

Dr. McCurdy, in closing, read a portion of the paper touching upon the statement that there must be atrophy of both the soft parts and of the bone, and referring to the nervous influences. He was one of those, he said, who believed in the existence of an abdominal brain, and that nutrition is presided over by the sympathetic nerves and not by the spinal system. The case reported by Dr. Ridlon confirmed that statement. If the capillaries through which the nutri-

tive supply reaches the part is presided over entirely by the sympathetic, then the reflexes in the spinal cord or in the base of the brain do not control nutrition, and atrophy must be looked upon as a lesion of the sympathetic, and not associated in any way with the reflex spasm of the muscles which pass over the joint, and which are in reflex spasm, not because of any nutritive changes, but because of the effort on the part of the muscles to prevent motion, and, hence, prevent pain.

A CASE OF CONGENITAL DISLOCATION OF THE WRIST.

By PHIL. HOFFMANN, M.D.,
ST. LOUIS.

The writer has reason to believe that the condition herein reported is very rare.

Congenital dislocation of the wrist, uncommon in itself, is almost invariably associated with club-hand and bone-deficiency. In the literature at my command I could not find the report of an *uncomplicated* case of congenital wrist displacement such as described below.

The child, a male, came under my observation one or two days after birth. The right carpus was displaced forward; the ligaments, which were lax and unstable, allowed easy though temporary reduction to the normal. There was no evidence of traumatism. The bones were normally developed.

The opposite upper extremity presented a condition of club-hand with deficiency of the lower half of the ulna and inward deviation of the hand. The right femur was three-fourths of an inch shorter than its fellow. I present only the photograph of the simple wrist

displacement, as it is to this that I wish to call particular attention.

The only treatment given was corrective manipulation by the nurse, which, however, was but carelessly and imperfectly performed.

The child is now over two years of age. The displacement, which is still present, can be temporarily reduced, though not with the same facility as at first; nevertheless, the child has good use of the hand.

Dr. V. P. Gibney exhibited in this connection a case of congenital dislocation of the wrist occurring in the person of one of the physicians present.

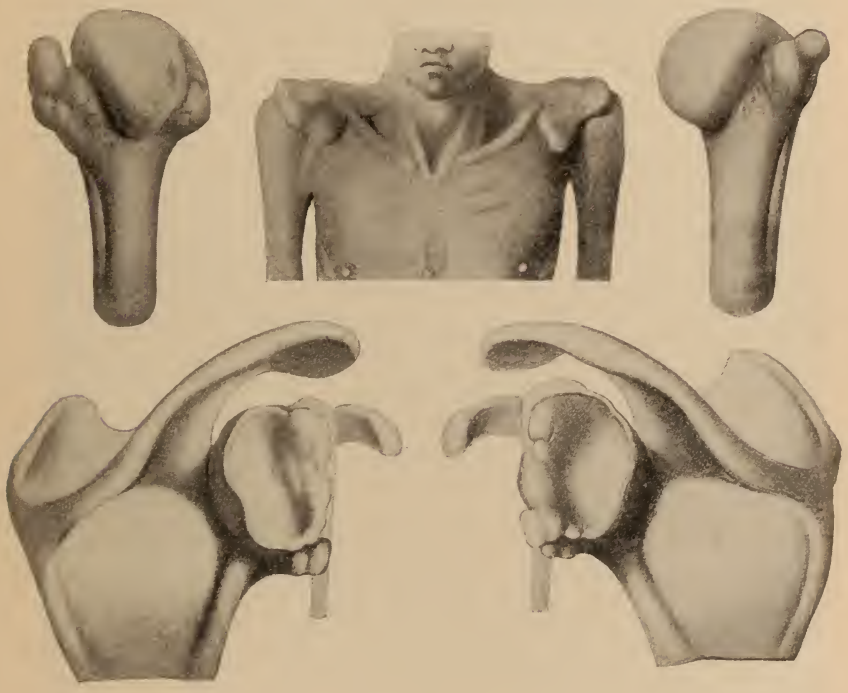
CONGENITAL DISLOCATION OF THE SHOULDER, WITH REPORT OF A CASE.

By JOHN LINCOLN PORTER, M.D.,
CHICAGO.

Congenital dislocation of the shoulder is so rare, and there is so little literature on the subject, that we are always interested in new cases of this deformity. The rarity of its occurrence is shown by Kronlein's collection of ninety-eight cases of different congenital dislocations from von Langenbeck's clinic, of which five were of the shoulder, while ninety were of the hip, two of the head of the radius, and one of the knee. The displacement is in the large majority of cases subspinous. Two or three have been reported as supra-acromial, and a few, especially those associated with paralysis, are described as subcoracoid. But the description of most of the undoubted congenital cases places the head of the humerus just posterior to the normal situation of the glenoid fossa, below the junction of the acromion process with the spine of the scapula. We still have to turn back to 1839 to Smith's classical description of the cases of the lunatic women for the pathology of the condition. I have photographed his plates of the Doyle case, as they show the condition in a subspinous dislocation in an adult of forty-two years. (Fig. 1.) They are also interesting as being the only illustrations of the conditions extant. In this case "there was no trace of a glenoid cavity in the natural situation, but upon the external surface of the neck of the scapula was a well-formed socket, which received the head of the humerus. It was . . . covered with cartilage and surrounded by a perfect glenoid ligament. The capsular ligament was perfect. The tendon of the biceps muscle arose from the most internal part of its superior extremity. The scapula was smaller than natural and its muscles badly developed." "The head of the humerus . . . was of an oval or oblong form, somewhat broader above than below; its anterior half alone was in contact with the glenoid cavity. This portion was covered with cartilage,

the remaining half being rough and scabrous and totally destitute of articular cartilage." "The lesser tubercle was elongated and curved, forming a most remarkable process; it was an inch in length, and bore some resemblance to the coracoid process. At its root it presented a smooth convex, pulley-shaped surface, around which passed the tendons of the biceps muscle." There is no doubt that some, and perhaps a large proportion of the cases of this deformity, are due to traumatism at the time of birth, and in studying

FIG. 1.



the subject, especially with a case at hand, one is struck with the necessity of differentiating these traumatic cases from those due to imperfect development. It is necessary because of the great difference in prognosis and the different lines of treatment indicated. It is also very difficult on account of the impossibility to palpate the deeper structures of the joint accurately enough to determine their exact condition. I believe Scudder has called attention to the one point of difference between these two classes upon which a differen-

tial diagnosis can be made, when he says that in cases due to imperfect development of the articular surfaces there will also be a difference in development between all the bones of that extremity and the normal one. If we make due allowance for the difference due to paralysis when it *co*exists, and to disuse in the older cases, I think we shall find this point worth more than any other in deciding the class to which the case belongs.

The various peripheral palsies of the arm, especially the so-called "obstetrical paralyses" due to injury of the cervical nerves at birth, may be confounded with congenital dislocation. The only resemblance between the two conditions is the position in which the arm is held. The paralysis *without* dislocation and the fact that, as the trouble dates from birth, there would be no difference in development of the two extremities, should make the differentiation easy. Then, too, the great majority of the paralytic cases tend to spontaneous recovery while the dislocations persist.

We also have as an aid in diagnosis the X-ray with fluoroscope and skiagram; but X-ray pictures are sometimes misleading and liable to misinterpretation, so we cannot depend upon them as positively as had been expected. Fig. 2 shows a skiagram of the following case:

W. S., a boy, four months old. First seen in November, 1899. History: Three older children, all perfectly formed. Labor with this child was not hard, and head presented, but labor was terminated with the aid of forceps after four hours because of the haste of the physician to go to another case.

Three days later the nurse noticed that the infant held the arm very still and in a peculiar position. Was examined by the physician, who said it was all right, except it was paralyzed a little as a result of pressure during birth, and advised electricity. This was applied for six weeks without apparent benefit. At the age of two months he began to move his hand and forearm somewhat. Two months later, when I first saw him, condition was as follows: Right arm held abducted, slightly flexed and rotated inward. (Fig. 3.) Hand and forearm kept moving constantly, but humerus moved voluntarily very little. Hand has apparently as strong a grasp as the left. Passively the elbow can be completely flexed; pronation of the forearm is normal; supination impossible, except to a very slight degree. The humerus can be adducted a little, but not carried across the chest; abduction is more free, but arm cannot be carried quite to

Fig. 2.

horizontal. There is slight flattening of the shoulder anteriorly, and a slight prominence posteriorly under the outer end of the scapular spine. With rotation of the arm this prominence is felt to move under the fingers, and is evidently the head of the humerus. With considerable traction it could be moved forward a little toward the glenoid cavity, but could not be replaced in its normal position, Without examination under anæsthesia, and considering the history, I was inclined to regard it as a traumatic dislocation, as was also Dr. Ridlon, who saw the case later. This opinion was strengthened

Fig. 3.

by the skiagram, as the neck and glenoid fossa seem to be equally developed on both sides.

On February 8, 1900, the patient was anæsthetized and reduction undertaken. The arm could then be moved freely in all directions except outward rotation, and after a few moments' traction the head could be pulled forward, and was distinctly felt to slip over what was supposedly the edge of the glenoid cavity and under the acromion, but when released it went back again to its former position. It was again reduced and held in that position while a plaster cast was put

on enveloping the chest and arm to the wrist, the arm being abducted and rotated outward, the elbow flexed, and pressure made posterior to the humeral head while the plaster was hardening. After three weeks, when the cast was removed, there was a tendency to recurrence as soon as the arm was moved. It was again put up in the same position and kept for three weeks, and again it tended to relapse when the cast was removed. This procedure was repeated, and again it would not stay in place. I then left the cast off for a week and sent the case to Dr. Mettler for examination for electrical reaction of the muscles. He reported that there was no evidence of any paralysis. I then made careful measurements of the bones of each extremity, as suggested by Scudder, with the following results:

	Right.	Left.
Acromion to external condyle of humerus	11 cm.	12½ cm.
" inferior angle of scapula	7½ cm.	8 cm.
Length of clavicle	5¾ cm.	6 cm.
" radius	8¼ cm.	9 cm.
" ulna	9½ cm.	10 cm.
Circumference of arm at deltoid insertion	13 cm.	13 cm.

From these findings I decided that the case is one of true congenital displacement; that the reason reduction is not permanent is either because the posterior border of the glenoid cavity is absent, as noted by Phelps in his cases, or possibly the entire glenoid cavity is lacking, as shown in Smith's case; and, if so, the head of the humerus may have made for itself a new articular facet posterior to the normal situation, and, if surrounded by glenoid and capsular ligaments, as noted in Smith's case, these also act as opponents to reduction.

In 1890, Scudder[1] said there were twelve cases reported. Looking up the literature from that time I find sixteen more, to which I append references. Counting my own, then, we have twenty-nine cases. In at least one-half of these there is doubt as to their being true congenital misplacements. What has been done as to treatment? Gaillard's[2] case was reduced by intermittent traction for three weeks with sixteen pounds weight, and reduction persisted after two years. Kuster[3] operated upon one case, which died. Scudder[4] has reported four cases; no treatment. Robinson[5] showed two cases in London in 1893, but reported no treatment.

Eve[6] operated on one case in 1895; good results, but operation proved the case to be probably traumatic.

Phelps[7] reported one operation in 1895, with good results, and refers to two others, the results of which he has never reported. Condition of the joint in the first case suggests that it may have been an early traumatic dislocation with fracture of the glenoid fossa.

Lewis[8] reports one case—suprascapular, infant, eleven months old—which was evidently traumatic, easily reduced under anæsthetics, and persisted in place.

Stimson,[9] in his last edition of *Fractures and Dislocations*, reports three cases: one operated upon, no result stated, as the case was lost sight of; in two no treatment. In all his cases he noticed the bones of the affected extremity were smaller than those of its fellow. In the case operated upon the glenoid fossa was smaller than normal, but formed.

Scudder[10] refers to a case of traumatic dislocation in a child, eight months old, operated upon by Stone, of Boston, with slight improvement.

We have, then, one case of possibly congenital dislocation and one undoubtedly traumatic, reduced and retained.

Three cases operated upon with good result, one without improvement, and three in which results are not reported.

All the rest have either had no treatment or it has been unsatisfactory.

From the above review I think we may draw the following conclusions:

1. It is of fundamental importance to discriminate between traumatic and developmental cases.

2. The pathology of the congenital cases is not sufficiently known to indicate the most promising line of treatment.

3. Sufficient operations have not been done to establish a successful method of operative treatment or add much to our pathological knowledge.

4. In cases determined to be developmental by the history and measurements, remembering the probable deficiency of development of the one or both articular surfaces, an early operation, before the humeral head has formed a new articular facet under the spine and has itself become deformed, offers the best results.

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DISCUSSION.

DR. A. M. PHELPS, of New York, said that he had eight cases of congenital dislocation of the shoulder, four of which had been operated on; the other four had been reduced under ether. Photographs of the four operative cases were exhibited. The first case was in San Francisco, and the ultimate result could be furnished by Dr. Sherman. The other cases were typical dislocations of the shoulder. The deformity was identical in each one. In all of them there was an inability to put the hand to the mouth, and it was impossible to bring the hand forward and turn it over. On cutting into these articulations he had found unquestionable fracture of the posterior border of the glenoid cavity in all. There was no absence of the glenoid cavity. In two or three of them the posterior rim of the glenoid cavity had been carried backward, but was still attached to the capsule. In all of the cases the glenoid cavity was semilunar in shape. These conditions led him to believe that this is always a traumatic affection, and that it is never a congenital deformity. On account of the non-development of that side of the body it had been said that we should classify these cases as congenital. If all of these cases and those of Scudder were measured it would be found that they presented the same measurements and conditions. Four of the cases reduced had been under one year of age. Under ether the dislocation was easily reduced. The arm was kept for three months in a cramped position with the elbow drawn backward and held by adhesive plaster. These cases had done well. The ninth case had been recently reported to him by Dr. Plimpton, in which it had been impossible to hold the parts reduced. Here he

suspected there was an absence of a proper glenoid cavity. The first operation he had performed, being a pioneer one, had been experimental, and without any guide except the anatomical principles. He had made an incision on the posterior border of the deltoid, and had split the capsule and removed nearly all of the head of the bone. If one removed the cartilage, bony union was bound to result. The cartilage was taken away, and the capsule was stitched up with chromicized catgut. The result had been good, but in one of the cases the accumulation of secretion in the joint had necessitated a secondary operation. This led him to believe that the first incision was wrong. Instead of making it along the posterior border of the deltoid muscle, it should be made sweeping downward on the scapula, and the flap turned upward so as to let one in under the deltoid muscle and down upon the capsule of the joint. Sometimes the arm could not be brought into proper position. This was because the pectoralis muscle offered resistance. The muscles in the bicipital groove should then be detached with a knife, or the humerus might be shortened still more, which would allow the bone to be turned around. A skiagraph of one of the cases was exhibited, showing the head of the bone out of the socket. He was decidedly in favor of operating upon the cases that he could not reduce. If these cases were attacked during the first year probably all of them could be reduced. If this could not be done they should be cut down upon immediately, and the operation just described performed.

Dr. V. P. Gibney, of New York, said that Dr. Porter's graphic description corresponded very closely to two of his own cases. He had tried the application of plaster in all positions, but he had not been able to get the pectoral muscles loose, and the head of the bone would slip out. To one child he had applied a spinal brace, which held the limb back, though allowing the hand to be brought to the mouth. This brace was kept on for periods of three months at a time. Where he had used adhesive plaster it had invariably caused excoriations in these cases, and the bone had slipped out. He believed many of these cases went to the neurological clinics, and were classified as Erb's paralysis, the true condition of dislocation not being recognized. He knew of one clinic where a massage operator was working upon half a dozen of these cases of so-called Erb's paralysis.

Dr. Harry M. Sherman, of San Francisco, said he could only speak of Dr. Phelps' case now from memory. The humerus is short. What represents the head of the humerus is in proper position. There is a certain amount of passive motion permissible in the joint—not more than fifteen or twenty degrees. This motion, however, was not used, all of the motions of the arm being made with the scapula, as shown by the boy's lifting the arm from the side as far as possible when the scapular motion and arm motion stop together. With passive motion the arm could then be carried still further, because of the motion in the joint itself. For some reason the child had no control over this motion. The operation has been of very great benefit by putting the arm in a better position in relation to the trunk, so that the hand can be brought to the front.

Dr. Phelps said that the other three cases had been operated upon for Dr. L. W. Hubbard, of New York, and he had reported that there was in one of these some paralysis present in the deltoid and in the extensor group of muscles. This had never been recovered from. The paralysis had been the result of injury produced by the accoucheur. In the other cases the arm could be raised half the distance to the horizontal. They could all put their hands to their mouths or in a position of one playing the piano. The two cases which had been reduced under ether were children under six months of age, he believed, and they had good motion, the head of the bone having remained in place. The other two had been reduced only in the past few months.

Dr. Porter said, in regard to the measurements of the different extremities, that there was, without the slightest doubt, a difference in the measurements between all of the bones of the affected extremities in his cases. The same had been reported by Scudder and Stimson. If the condition were due to traumatism at birth, measurements made within a few months after this event should not give such differences. He maintained that we should differentiate between the cases which were truly congenital and those of traumatic origin. Where there was a difference of development in the extremities it was logical to assume that this was due to differences of development in intra-uterine life.

RAPID OSTEOCLASIS FOR THE CORRECTION OF RHACHITIC DEFORMITIES OF THE LEGS.

By WALLACE BLANCHARD, M.D.,
CHICAGO.

In using the term "rapid osteoclasis," I desire to be understood as speaking of supracondyloid fractures of the femurs for the correction of genu valgum or genu varum, and of fracture of the tibias for the correction of anterior or lateral deformities as occupying not over eight seconds for actual operative work with the osteoclast.

In rapid osteoclasis the time taken by the operator when the patient is placed ready, anæsthetized, on the table, may be divided as follows: For the actual operation of osteoclasis, seven or eight seconds; for correction under the hands alone, five to eight seconds; for applying the plaster-of-Paris dressing, two minutes, and holding the parts in the corrected position till the plaster "sets," three minutes; and at the end of not less than five and one-half minutes the patient has been removed from the table and the operator may be awaiting another case.

A whole ward full of from a dozen to twenty cases of bowlegs, knock-knees, and bent tibias may be corrected by rapid osteoclasis in the time I have frequently seen taken for one Macewen supracondyloid or one cuneiform osteotomy.

The compression of the soft parts is of such transitory nature in rapid osteoclasis that the tissues rebound instantly into their normal condition, the circulation is immediately resumed, and no bad or even unsatisfactory effects are ever observed.

The ultimate results of the operation for correction of these deformities of the legs as affecting the stature of a class of patients that exhibit almost invariably a stunted development may be considered as of paramount interest, second only to the correction of the deformities.

I have frequently demonstrated in the correction of bad anterior deformities of the tibias that cuneiform osteotomy on a child from six to ten years of age shortens the leg about one inch, while osteoclasis of a similar leg lengthens the leg about one inch.

If Fig. 1 be taken to represent a case of anterior rhachitic curve of the tibia, and the wedge of bone to be removed by a cuneiform osteotomy be represented at A, when that wedge is removed and the triangular space left has been closed in by the straightening of the tibia the result may be a straight leg, but shortened about one inch, as in Fig. 2; but if the opposite course be pursued with Fig. 3

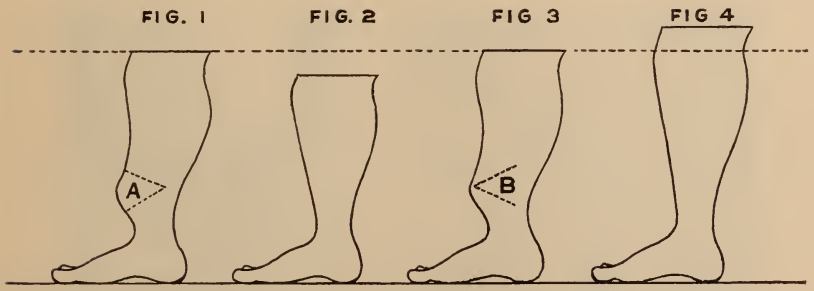


FIG. 1.—A leg with an anterior rhachitic curve in the lower third of the tibia. A. A triangular wedge of bone to be removed by a cuneiform osteotomy for correction of the anterior deformity in the tibia.

FIG. 2.—The ultimate result of cuneiform osteotomy may be a straight leg, but with one inch of shortening.

FIG. 3.—A leg with anterior rhachitic curve in the lower third of the tibia, the same as Fig. 1. B. The triangular space to be opened up in the fracturing and straightening of the tibia by osteoclasis.

FIG. 4.—The ultimate result of osteoclasis is a perfectly straight leg, and lengthened one inch.

(which is supposed to be exactly the same as Fig. 1), of fracturing by osteoclasis and straightening the leg by opening up a triangular space represented at B, the ultimate result will, as seen in Fig. 4, be a straight leg and lengthened one inch.

Practically, all the cases of bent tibias from early rickets are undersized and many are dwarfed. To all of these two inches difference in ultimate stature means very much indeed, and it is a consideration that I believe the surgeon has no right to disregard, and, certainly, next to the correction of the deformity, an increase in stature is of the greatest concern to the patient.

Case I. is a girl, twelve years of age, with very prominent anterior and lateral rhachitic curves of the tibias, and shows a left thigh adducted so as to look like a severe knock-knee of the left side, and, in fact, so marked was the condition that at first sight it might have been apprehended that after the tibias had been corrected an operation on the left femur would be necessary. The tibias presented their anterior and inward curves in the lower thirds, the left tibia presenting a lateral bend of upward of forty-five degrees, so that in order to place the left foot flat on the floor, she had necessarily to

Fig. 5.

Case I.—Before and after the correction of anterior and lateral rhachitic curves of the tibias by rapid osteoclasis.

adduct the left thigh till it laid across the right, and this condition was so pronounced that while the patient could walk fairly well with a swaying gait from side to side, in standing the centre of gravity was entirely lost, and she had to hold on to some fixed object to save herself from falling.

After both tibias had been straightened by rapid osteoclasis the patient ceased to adduct the left thigh and stood as seen in the second cut of the same case, from a photograph taken six weeks after the operation, perfectly straight, with the soles of both feet on the floor, and

she walked with an even movement. And further than this, by the correction of the anterior curves, the tibias had been lengthened just one inch, and the patient expressed as much pride in her increased height as in her straightened legs.

Frequently, when the tibia is to be lengthened considerably, the tendo-Achilles must be tenotomized as a preliminary step to allow it to lengthen correspondingly.

In unilateral anterior contortion of the tibia, where the bent leg, as is usually the case, is about an inch short, it would seem inexcusable to perform cuneiform osteotomy that would leave the leg two inches short, when osteoclasis would bring it out to a full length with the unaffected leg, and at the same time make a perfect correction.

Highly exaggerated over-correction of the tibias in appropriate cases shows wellnigh astonishing results. In cases of bowlegs following early rickets, where the deformities are caused about equally by the three conditions of bent femurs, large outer condyles, and bent tibias, the outward curves in the legs being about evenly distributed from the hips to the ankles, exaggerated over-correction of the tibias will frequently result in perfectly straight legs.

At the Home for Destitute Crippled Children, Chicago, we are in the habit in these cases of fracturing the tibias between the middle and upper thirds, even if most of the bend in the tibias be below that point, and of over-correcting the tibia to a highly exaggerated degree, so that when put in plaster-of-Paris the legs look as if they must come out in a series of zigzag shapes; but when the dressings are removed and the patient stands on his feet, the exaggerated over-correction of the tibias seems to assimilate into the general contour of the legs and to neutralize the large outer condyles and the bent femurs, so that the legs almost invariably present symmetrical contours, and for all purposes of use or appearance are perfectly straight.

Case II. is a boy, aged six years, with very pronounced bowlegs, in which the operation was an osteoclasis and exaggerated over-correction of the tibias at the upper thirds, the excessive over-correction compensating for both the bent femurs and the large outer condyles, and the result is seen in the second cut of the same

case from a photograph taken five weeks after the operation, to be a pair of straight legs.

The bowlegged frequently stand and walk with the legs abducted to an abnormal extent, as is well shown in the first cut of Case II. This abduction is due to the fact that with pronounced outwardly bent legs the feet are rolled out in accommodation to the changed direction of the tibias at the ankle articulations, so that the plantar surfaces must face inward, and walking must be on the outer margins of the feet, unless, as is almost invariably the case, there is a voluntary abduction of the legs till the lateral plane of the plantar surfaces of the feet are parallel to the floor.

Fig. 6.

Case II.—Before and after the correction of genu varum by rapid osteoclasis and exaggerated over-correction of the tibias.

As seen in the second cut of Case II., the straightening of the legs by exaggerated over-correction of the tibias corrects the abduction of the legs.

Occasionally, bowlegs may be presented with large outer condyles, but not so large as to account for the pronounced bowlegs, and the same case may also present bent tibias, but not so marked as to be accountable for more than half of the deformity, with some bend in the femurs and no pronounced symptoms of early rickets; and then it may, of course, be judged that the child walked early, and that the

large condyles gave a strong lateral leverage on the long bones before they had acquired sufficient firmness to maintain a perfect resistance, and that the large outer condyles, by misdirecting the weight of the body, were primarily responsible for the deformity. In such cases exaggerated over-correction of the tibias will almost invariably give excellent results.

The same may be said of knock-knees and the fracturing and exaggerated over-correction of the tibias so as not only to overcome the bend in the bones broken, but also to correct any deviation caused by enlarged inner condyles and bent femurs as well as if they were present, and the result will usually be found to be straight legs and no remaining necessity of supracondyloid operations.

The first two cases here presented were selected out of a large number, with a view of showing that many anomalous conditions of the legs may accompany or be dependent on bent tibias, such as adduction, abduction, rotation, enlarged inner or outer condyles, and bent femurs, that may be relieved or entirely neutralized by the correction or exaggerated over-correction of the deformed tibias.

The fractures in rapid osteoclasis are always simple and without any complications whatever, and hardly once in twenty times does the patient complain of even the least pain succeeding the operation. In fracturing the tibia for correction of anterior deformity, the force of impact should be in the direction of least resistance, which is usually lateral and without regard to the direction of the bone deformity; the fracture produced should be quite complete, and the correction of the deformity should be made by hand-force alone.

In fact, the fracturing in the osteoclast in a lateral direction is but the first step, and the second step is to straighten the tibia by manual force, and this opens up a triangular space in the shaft of the tibia which will have its apex well forward toward the crest and its base at the posterior aspect of the bone. The leg, while being held straight, or in an exaggerated over-corrected position, if desired, should be put up strongly in plaster-of-Paris dressing and the rapidity of the union shows that the gaps left in the tibias readily fill with callus.

An entirely different course should be pursued with rapid osteoclasis in the correction of lateral curves of the tibia. In these cases the leg may be so placed in the osteoclast that the pressure of the

fracturing-bar will be exerted directly against the most prominent point of the bent bone, so that the bending or fracturing, while being lateral, will be in a direction opposite to the deformity curve. The force of the instrument should be used only to such a point as may be necessary to correct or slightly over-correct the deformity, and, in a large majority of cases, a bending of the bone without any fracture whatever is all that is necessary for the correction of very marked lateral deformities of the tibias, though occasionally a four-fifths fracture is required.

The same course may be pursued where exaggerated over-corrections of laterally bent tibias are desired for the correction of deformities above or below those directly operated upon, and the fracturing should then be carried to and stopped at a point where manual force alone may be sufficient to complete the fractures and to place the bones in any desired position of exaggerated over-correction.

In neither of these procedures is the integrity of the soft parts in the least endangered.

In nearly three-fourths of the cases of the supracondyloid corrections in quite young children, and occasionally up to ten or twelve years of age, an osteocampsis is all that is necessary, the bending of the femurs without fracturing being entirely sufficient for the correction of even severe types of bowlegs or knock-knees.

The most perfect ultimate results of supracondyloid osteoclasis or osteocampsis are attainable by selecting the place for fracturing or bending at the lowest point where the least lateral resistance will have to be encountered, and that is where the bone is the average thickness of the shaft and just above where it begins to widen and thicken to form the condyles. Three-quarters of an inch above the prominence at the anterior upper and outer margin of the condyle has been long accepted as safely above the epiphysis for the placing of the chisel in a Macewen osteotomy. If the same point is selected for the placing of the lower resistance-bar of the Grattan osteoclast, it must be conceded immediately that there is no danger whatever to the epiphysis, and this leaves as the most conspicuous point of interest to the operator the fact that there is plenty of space left in which to place the fracturing-bar at the very point where, with the greatest ease, the best results of osteoclasis or osteocampsis in the straightening of bowlegs and knock-knees can be obtained. I have seen quite a

number of supracondyloid osteoclases where the lower resistance-bar was placed at or below the epiphysis, and have never observed any bad results, and probably for this reason, that if the pressure points leave any latitude to the bone, it will bend and fracture an inch above the epiphysis, where the bone is only two-thirds as thick, rather than at the epiphysis, where the resistance is perhaps one-third greater. In fact, I do not believe that a fracture ever occurs at the epiphysis under the osteoclast, even when no care is taken to save the bone pressure from extending to both sides of the epiphysis. However, as nothing whatever is to be gained by fracturing or bending the femur at any point lower than has just been indicated, any danger to the epiphysis may cease to be a matter for consideration.

CASE III. is a boy, aged six years, with knock knees, in which the deformity was perfectly corrected by a rapid supracondyloid

FIG. 7.

CASE III.—Before and after the correction of genu valgum by rapid osteocampsis of the femurs.

osteocampsis; the bending of the femurs in the osteoclast being accomplished without fracture. This case also exhibited anterior curves at the lower thirds of the tibias, which are not as well shown

in the first cut of the case as they would have been in the side view, and these were corrected by rapid osteoclasis. The second cut of this case is from a photograph taken five weeks after the correction of the knock-knees by rapid supracondyloid osteocampsis.

Dr. Lorenz, of Vienna, corrects knock-knee by stretching the external ligaments of the knee in the osteoclast and straightening the leg by separating more or less widely the external condyle from the head of the tibia. That this is followed by several days of most excruciating pain, no one who has ever suffered from a severe sprain will for one moment doubt. After the operation the leg is put up straight in a plaster bandage, and after six weeks that is removed and a walking knock-knee brace is put on and worn for one year, when the case is said to be cured.

We know from the pathology and etiology of genu valgum that the elongated and enlarged condyle cannot be removed except by a supracondyloid osteotomy, osteoclasis, or osteocampsis, and to leave the primary cause of the deformity might seem to be courting a relapse. Are there any advantages to be seen in Lorenz's method of correction which requires a year's time for its completion, when a supracondyloid osteocampsis or osteoclasis will invariably give a straight leg with the elongated condyle perfectly corrected and the patient walking comfortably in four or five weeks, without necessity of a brace of any kind?

It is well known that when the bones harden after the rickets of early childhood they frequently harden to an unnatural density and firmness, and so occasionally a child whose bones have been so soft as to bend into all sorts of shapes under its weight at the age of two years will have bones at the age of eight or ten that will be as firm and resisting and will break under the osteoclast with as loud a snap as in a man of forty.

I believe that rapid osteoclasis offers every advantage given by osteotomy, either linear or cuneiform, and none of its many disadvantages, such as the time and expense of the necessary aseptic conditions before and after the operation and the time consumed in an open operation in controlling the hemorrhages, sawing and chiselling, and the many other steps to the suturing and closing of the wound, to say nothing of the pain succeeding such operations and of the danger of infection that always hovers around an open wound.

And as to danger and pain, there is undoubtedly all the difference between an osteoclasis and an osteotomy that exists between a simple and a compound fracture.

At the sixth session of this Society, held in New York, September, 1892, I had the pleasure of seeing the late Dr. Nicholas Grattan, of Cork, Ireland, demonstrate the use of his osteoclast, and now, after eight years, it seems to me that the instrument has not gained the popularity which it deserves.

I have watched the conditions arise and objections that have now and again been advanced that have helped to keep in disfavor the Grattan osteoclast, and they may be summarized as follows:

The Grattan osteoclast was said to be too heavy to be easily portable, and the instrument makers in New York and other cities were instructed to make an osteoclast on the model of the perfected Grattan, but very much lighter; and next great care was urged, possibly by those who had never operated the osteoclast, that it be used with plenty of time and with due deliberation, so that the soft parts should not be contused and injured, and that bloodvessels should not be ruptured; and, lastly, as far as my knowledge goes, nearly every orthopedic surgeon that has said anything on the subject has expressed about the same opinion as that given by Dr. De Forest Willard in a paper on "Osteotomy," read October 28, 1899, before the American Medical Association, in which he said: "The osteoclast contuses and lacerates the soft tissues to a marked degree, and the traumatism inflicted is infinitely greater than the clean incision of osteotomy."

Some familiarity with the Grattan osteoclast teaches the operator that the great weight of the instrument gives it the stability and precision that inspires confidence in the operator, and the reduction in weight of the instrument as made in this country has necessarily ruined it for practical work, as such an osteoclast must undoubtedly lack the steadiness, accuracy and strength of the original, and I cannot regard the making of a lighter instrument on the same plan of the Grattan as anything less than a most unfortunate mistake.

As to the advice to take plenty of time and be deliberate in an osteoclasis, there is no doubt but that time and deliberation do cause compression of the soft parts that must frequently result in

unfortunate lesions, and that such handling of any osteoclast will lead to its being laid aside in disfavor. But if rapid osteoclasis is done with the Grattan the compression is of so short a duration that the soft tissues spring quickly back into their normal condition, the circulation of the parts is immediately restored, there is absolutely no injury inflicted, and no bad results are observed. I can only conclude that those expressing similar opinions to Dr. De Forest Willard have not practised rapid osteoclasis with the Grattan.

Dr. James K. Young, in his treatise on *Orthopedic Surgery*, in speaking of knock-knees, says that "when the deformity lies chiefly in the head of the tibia that osteotomy is a necessary operation," and he states his objection to osteoclasis in this way: "Lack of precision, splintering of the fragments, and separation of the epiphysis." But in my experience with knock-knees, as also with bowlegs, the fault seldom, if ever, lies chiefly in the head of the tibia, but nearly always, when not due to a bending of the shaft of either the femur or tibia, to elongated inner or outer condyles of the femur, and is safely and perfectly correctable by rapid osteoclasis, without any danger whatever of splintering the bone or separation of the epiphysis.

Drs. Bradford and Lovell, in the second edition of their *Orthopedic Surgery*, limit the osteoclast to operations in the shaft of the tibias, and only mention osteoclasis near the joints as being "difficult," and they do not recommend it. With the Rizzoli osteoclast which they use, as also with the Lorenz, the Thomas, the Collins and with all others which I am acquainted, with the exception of the Grattan, they are certainly right. The pads and straps on most of these osteoclasts stretch and give so as to render them uncertain and variable in action, and they all require comparatively extensive fields in which to operate. But the narrow space in which the Grattan can act, enabling the operator to break or bend as near to either joint as could reasonably be desired, with the fact that the three upright bars—two for resistance and one for the direct force—are all of bare and rigid steel, without pads or straps to misdirect or make uncertain the force applied, together with its rapidity of action and great steadiness, make it to me the ideal osteoclast. With the Grattan there is no giving or slipping, and the fracturing bar can be sent with a steady force that is irresistible to the accomplish-

ment of a simple uncomplicated fracture, and with an ease, accuracy and rapidity that possibly may never be improved upon.

Dr. James E. Moore, in his *Orthopedic Surgery,* says that osteoclasis should not be used in anterior rhachitic curves of the tibias, "because the sharp crest of the tibia is liable to cut through the skin," and advises cuneiform osteotomy. Plenty of time might be left for repentance if one should either try to break a sabre over his knee, with the knee pressure placed against the sharp edge, or should put the force of a fracturing bar of an osteoclast against the shaft crest of an anteriorly bent tibia. I have never seen such a rashly unadvised operation; and, indeed, the accident referred to is impossible if the fracture is produced laterally and in a line with the least resistance, and the deformity is corrected with the hands.

Dr. J. Jackson Clarke, London, England, in his *Orthopedic Surgery, a Text-book of the Pathology and Treatment of Deformities* —which is, I believe, the latest book on the subject—while favoring the Grattan osteoclast, only touches on the subject of osteoclasis in a general way, and says that fractures should occasionally be made of the epiphysis. Why or when this should be done he does not say. Seemingly, however, he does not apprehend any danger of dwarfing the development of the bone by so doing, and in general I believe that the European and American surgeons do not agree as to the danger of disturbing the epiphysis. I doubt that any operator with the osteoclast was ever quite certain that he had separated the epiphyseal junction, for, if not impossible, it is certainly hard of attainment. In most of the long bones, and in the lower end of the femurs particularly, in the distance of an inch from the epiphysis into the shaft of the bone it thins down full one-third; and if any latitude is given between the points of pressure, the break will invariably be at the thinnest point allowable, which will be away from the epiphysis, and so the epiphyseal junction is really never in any danger of separation.

While I believe that Dr. James E. Moore voices the general opinion when he says that for the correction of knock-knee osteoclasis is "neither safe nor satisfactory," and that "Macewen's osteotomy is now universally employed," nevertheless for two years we have used supracondyloid rapid osteoclasis or osteocampsis in nearly all our cases of knock-knees (that have not been more easily

corrected by fracturing and over-correction of the tibias) with results that are entirely and perfectly satisfactory, and I believe with nearly if not quite absolute safety, for we have never as yet had an accident or a bad result.

Fractures may also be made of the tibias as near to the knee- or the ankle-joints as could be deemed necessary for practical purposes with equal safety and exactness. I can hardly conceive of an osteoclast being made that can serve the purpose of rapid osteoclasis either close to or remote from joints with greater precision and safety than the Grattan.

The absence of pain succeeding a rapid osteoclasis should perhaps be a point in its favor. Usually the next day the little patient is found to be enjoying its playthings on the bed quite as happy as if nothing had happened.

Speedy unions are the invariable rule, and at the end of the fourth week the plaster may, in most cases, be removed and the patient allowed to walk about without braces or supports of any sort.

We have operated for two years at the Home for Destitute Crippled Children, Chicago, on the lines suggested in this paper, and frequently on four or five cases in an afternoon, with most satisfactory results and without a single mishap of any kind.

I have made a series of experiments with fresh bones, which, I believe, prove that fractures under the osteoclast follow certain exact rules, with only slight variations, and as these fractures have always been referred to in a vague sort of way as "subperiosteal and partial," or "complete and perhaps splintered," it would seem that a definite knowledge of the subject was desirable.

When a child's tibia bends under the Grattan osteoclast the side opposite to the point of pressure curves outwardly, and a transverse line of depression and impaction forms on the side next to the pressure bar, and this depression deepens and the impaction becomes more pronounced as the bend increases, up to perhaps about six to ten degrees. This is the condition in which the bone is left after an osteocampsis, and has been termed, with perhaps doubtful propriety, a subperiosteal fracture. As the pressure is increased a loud snap is heard, and the bone has developed a fracture opposite to the pressure point of four-fifths of the thickness of the shaft, with a transverse and often smooth cleavage, though occasionally this is

quite irregular, but there is never any splintering. The unfractured fifth of the bone lies next to the pressure bar, and the transverse line of depression has disappeared, while this portion of the shaft presents a rounded contour with a slight longitudinal split of half an inch to an inch, extending each way from the base of the transverse section. No stopping point was at any time observed between an osteocampsis and a four-fifths fracture.

Incomplete would seem to be a fair name for this break, though the term which I have applied to it of a four-fifths fracture is certainly more plainly descriptive. With five to ten degrees more of bending the remaining fifth of the shaft fractures with an irregular line of separation, but no splintering, and the fracture is complete. The more brittle bones usually required much greater force and went to a complete fracture, with less bend and without any intermediate stage. The break was frequently transverse and smooth, but sometimes with an irregular line of separation and never any splintering. In the bending and breaking of bones under the osteoclast, I seldom found any variation worth noting from the stages described.

If I have been able to show the Grattan osteoclast in something of a new light, and to present clearly even a portion of its capabilities, then, indeed, do I hope that the time is at hand when at least a fair proportion of the corrections of the deformities resulting from early rickets will be by the bloodless and comparatively safe operations of rapid osteoclasis or osteocampsis.

There is very little literature on the subjects of osteoclasis and osteocampsis. So far as I am able to learn, there is none whatever on increasing the stature of the undersized and dwarfed subjects of bent and crooked legs from early rickets while correcting their deformities, or on the exaggerated over-correction of deformed tibias for the neutralization of the effects of enlarged inner and outer condyles and bent femurs, and yet I submit that these subjects are worthy of some consideration.

Dr. A. H. Tubby, London, England, in his *Orthopedic Surgery*, dismissed the whole subject of osteoclasis in less than two lines; while Dr. J. Jackson Clarke, London, England, in his *Orthopedic Surgery*, just issued, gives it ten lines.

Our American authors are hardly more liberal in their treatment

of the subject, and one looks in vain through a meagre literature for a single idea of the technique to be followed in correcting the many and varied rhachitic deformities of the legs by osteoclasis and osteocampsis, and yet the subject may appear to be worthy of general attention and very earnest work.

DISCUSSION.

Dr. G. G. Davis, of Philadelphia, believed the author of the paper was right in his position regarding the efficacy of the osteoclast, but anyone who had seen the Grattan osteoclast exhibited at the last annual meeting must admit that it is a very unwieldy though powerful instrument. At that time he had suggested scoring the concave side of the curve with a chisel, and then completing the section with a much lighter osteoclast. Concerning the correction of antero-posterior deformities of the tibia and the increase of one inch in length, he said he would like to know the condition of the fibula during that correction, as to whether the ends separated at the site of fracture.

Dr. R. H. Sayre, of New York, said he was surprised at the suggestion made in the paper that the plaster-of-Paris casts should be taken off at the end of four weeks after such operations, because in many of these cases the callus was not sufficiently hard to allow of this being done without danger of relapse. The length of time supports must be worn afterward must depend upon whether or not the rhachitic bones had become hard. It was better, of course, to bend them straight while soft. After this bending the skiagraph would often show a distinct niche in the bone. The correction of the deformity should be made at the deformity and not at some uncertain point elsewhere. In taking skiagraphs of these legs he had learned that the bend in the bone was often not where it seemed to be from external examination. In some cases of bowlegs he had found that the curve was in the femur, and not in the tibia, as he had supposed, from palpation.

Dr. T. Halsted Myers, of New York, said that in a young child it was possible to correct almost any degree of deformity without any

cutting operation. He used the osteoclast frequently in his service at the New York Foundling Hospital, and had found that if the pressure bar were applied on the inner side the bone could be fractured much more easily than if applied on the outer side.

Dr. A. M. Phelps, of New York, thought there should be a rule to break as many times as might be necessary to correct the curves, and at the points of these curves.

Dr. John Ridlon, of Chicago, took issue with Dr. Phelps and others as to breaking the bones in half a dozen places. What the patient wants is a straight leg, with the least injury and the fewest possible operations. If the correction could be done by one operation, that was all that should be done. Legs having several curves could be made straight by a single operation. He had himself done six fractures on a child at a single operation, but not often was it necessary to make a number of fractures; hence, he opposed the rule laid down by Dr. Phelps.

Dr. Blanchard said where a large condyle was the primary cause of bowleg or knock-knee, and where the bend was about evenly distributed between the tibia and the femur, it would seem to him to be unnecessarily severe treatment to remove a portion of the condyle and fracture both the tibia and the femur, when experience showed that by the one simple operation of fracturing the tibia at the upper third and over-correcting it the leg could be made perfectly straight.

CONGENITAL DISLOCATION OF THE HIP-JOINT.

By E. H. BRADFORD, M.D.,
BOSTON.

The collected experience of the operative treatment of congenital dislocation of the hip-joint has demonstrated the following facts:

In many cases successful reduction of the dislocation has been performed. Frequently, however, relapse has occurred after apparently successful reduction. Relapse is more frequent after the operation without incision than after operation with incision. Operative treatment, with or without incision, lacks precision.

Among others, it will be seen that an important obstacle is encountered by the surgeon in a fold of the capsule attached to the lower part of the acetabulum, which may be termed an acetabular or capsular hymen, and is often pressed in front of the entering head of the femur, allowing apparent, but preventing complete reduction, and favoring relapse as the limb is placed in certain positions.

An anatomical knowledge of the contracted tissues has been acquired, and means have been devised for stretching, tearing or dividing, by force or incision, the contracted tissues. Where this has been done the head can be placed under the upper edge of the acetabulum, but frequently an elastic resistance is encountered which prevents a complete reduction well in the acetabulum, without which relapse occurs.

Where the opening is sufficiently large to admit the entering head into the acetabular pouch through the constricted portion of the capsule, without pushing the acetabular hymen between the head of the femur and the bottom of the acetabulum, complete reduction can be effected.

It does not, however, follow that the reduced head will remain permanently in place after the retaining bandages have been removed,

for the reason that a relaxed capsule and the lengthened pelvi-trochanteric muscles may be inefficient in holding the head in its normal place.[1] Furthermore, the neck of the femur is often so twisted, that to retain the axis in its proper direction in relation to the acetabulum it is necessary that the femur be twisted inward, a position incompatible with locomotion, and an anterior dislocation often follows.

The way in which it is planned that these conditions be overcome in the treatment without incision is as follows: First, by retaining the introduced head in the acetabulum under such pressure that if a fold of the capsule is interposed between the head and acetabulum, it will in time be absorbed under pressure; also on the supposition that

FIG. 1.

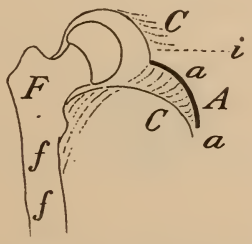


FIG. 2.

FIG. 1.—Section of congenital dislocation of hip. *A*. Acetabulum. *F*. Femur. *C*. Capsule with ligamentous attachment to *i*, ilium; *f f*, femur; *a a*, sides of acetabulum.

FIG. 2.—Capsule dissected from attachments to neck of femur and lesser trochanter. Lower part of capsule not freed from attachment to sides of acetabulum.

the loose capsule, lengthened muscles, and twisted neck will be gradually changed by adaptive alteration if the limb is held sufficiently long in the proper position.

It is unnecessary to state that it is not strange under these conditions that relapses are not infrequent. It is as true with this as with other procedures in surgery, that if the essential indications are met, a cure is effected; if not, relapse occurs.

[1] The influence of the capsule in retaining the head in the socket is well illustrated by a case of infantile paralysis in a child of two years, affecting all the muscles of the hip. The adductor muscles were entirely paralyzed. In placing the limb in a position of forced abduction on manipulation, it was possible to subluxate the hip slightly, but not to the extent that could be done in a congenital dislocation under an anæsthetic. The ligaments, however, appear to hold the limb more firmly than is the case in a reduced congenital dislocation.

It is manifest that for the best result as little injury as possible be done to the tissues. Little is inflicted if the following procedure be carried out:

FIG. 3.

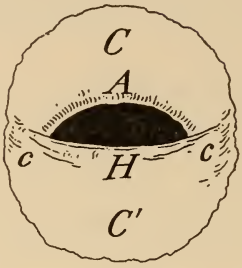


FIG. 4.

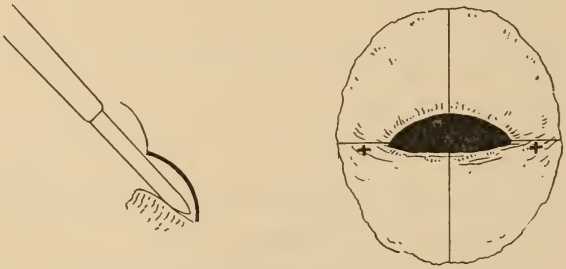
FIG. 3.—Capsule after dissection from femur. View facing acetabulum, femur not shown. *A*. Acetabulum. *C*. Capsule above acetabulum. *C'*. Capsule at acetabulum with attachments to side of acetabulum, *c c*. *H*. Folded capsule making a hymen, preventing introduction of head.

FIG. 4.—Partially reduced head of femur under lip of the acetabulum prevented from full introduction by fold of the lower part of the capsule, the capsular hymen.

An incision is made along the outer and anterior edge of the femur, reaching from above the greater trochanter to two inches below the lesser trochanter.

The upper portion should be curved slightly upward so as to uncover the head and neck of the dislocated femur.

FIG. 5.



Incision + divide capsular hymen.

The tensor vaginæ and gluteus medius muscles are separated, and the insertion of the gluteus maximus along the femur is avoided. When the femur is reached the femoral insertion of the rectus is

pushed aside, and the attachments of the psoas and iliacus are pushed away by a periosteum elevator, the lesser trochanter being well bared.

The capsule is then opened and cut across, first on the head in the line of the axis of the neck, and then from the neck downward toward the acetabulum, in front and behind. The finger is then inserted and the acetabulum exposed and the size of the capsular neck estimated. The capsular insertion on the femur is then entirely cut away, and the ligamentum teres if present, and the head of the femur pulled aside.

If the capsular neck is sufficiently large the head of the femur can be passed through it readily into the acetabulum and the capsule stretched over this; but if not, the lower portion of the capsule is to

FIG. 6.

FIG. 7.

FIG. 6.—Acetabulum uncovered.

FIG. 7 —Split capsule stitched around femur and overhead, forming a new and firmer capsule.

be held upon the stretch by hooks or by two inserted stitches. A blunt-pointed bistoury is inserted into the acetabulum, and the acetabular hymen is divided from within out.

The head of the femur should be placed in the acetabulum and the incised capsule stretched around the neck and secured by catgut sutures to the cut tissues around the neck or to the opposing parts of the cut capsule.

That this be accomplished it is necessary first that all contracted tissues which prevent pulling the head to the level of the acetabulum be lengthened. This can be done in suitable cases, as has been shown by clinical experience.

It will be found advisable in some of the more resistant cases to supplement stretching the contracted tissues by division of the mus-

cular fascia through an open skin incision. An oblique incision is made along the middle of the thigh across to the bellies of the hamstrings and the adductors, and the intermuscular fasciæ are divided and the limbs pulled into place.

In certain cases the stretching is accomplished with but little difficulty in manipulation, especially by forcible abduction carried to an extreme, stretching the adductors and hamstring of the straightened leg; but in some cases this is not easy, and in those here reported it has seemed better to forcibly stretch with myotomy, if necessary, in a preliminary operation, the dislocation being practically reduced by the bloodless method, and the limb properly secured by plaster bandages. If at the end of a month it seems that the head is not sufficiently firm in its normal position, preparations for operation are made and the head securely placed in the acetabulum, according to the method of operation already described.

This necessitates a second operation, an evil which seems less than the increased shock of a serious operation in addition to prolonged violent stretching.

In the cases operated upon in this way it has not seemed necessary to curette out the acetabulum. This diminishes the danger of stiffness after the operation.

In certain cases after operation it will be found, owing to a twist of the neck of the femur, or an anterior obliquity of the plane of the acetabulum, that unless the limb is forcibly turned inward the head of the femur, although well in the acetabulum when inverted, is in a position of forward dislocation when the foot points forward.

Under these circumstances an osteotomy of the femur is necessary. This can be performed at the middle or lower end of the femur, in the latter case by an osteotome; in the former by a Wyeth's fragment saw or by a Gigli wire saw.

It is believed that an osteotomy is of advantage as high up in the femur as is compatible with safety after injury to the blood-supply of the upper part of the femur incidental to the dissection of operation.

This weakens the dislocating force of the adductor and hamstring muscles, and can be utilized in correcting or diminishing the deformity of coxa vara often found in the congenitally dislocated femur. Attempts have been made to secure, until healing is well

established, the reduced head in place by passing a silver wire through the trochanter and the skin, and another through the tuberosity and the skin, and tying firmly the free ends of the silver wire together, protecting the underlying skin by felt or rubber. In two cases where this was tried this procedure has worked satisfactorily, but where the head is well placed in the acetabulum this precaution seems unnecessary if the limb is well secured by a plaster-of-Paris spica.

The wound, though a deep one, will be found healed after from two to three weeks, if strict aseptic precautions are used.

Strict aseptic precautions will be found necessary, for the reason that a joint cavity, rudimentary in character, and not subjected to the absorption of retained blood, is opened and plugged by an introduced femoral head. An elevation of temperature for a day or two immediately following the operation is usually seen even in wounds which heal rapidly, thoroughly, and permanently without suppuration and without any evidence of sepsis.

It has not been found necessary to retain the limb in any abnormally peculiar position during the healing process. A plaster-of-Paris spica is worn for two months with the limb slightly abducted; after this a stiffened leather spica is worn. The patient is allowed to stand and walk with this, using it from two to three months.

These conclusions are based upon the past nine years' experience in this operation, with improving results each year. The operations have been done on children ranging from fourteen to one year, and from three to six years of age, but most satisfactory in ages of two and over, and under seven.

It is believed that as improvements in skill increase the range of suitable ages for operation will be extended.

It is not claimed that the operation by incision can be permanently successful; it is claimed that it is successful in many cases, and when details here mentioned can be carried out it can be expected that it can be performed without danger to the patient, with precision and with a reasonable chance of success, with practically no serious injury to the tissues.

The 34 cases (single and double), that is 44 hips, operated upon by the writer may be grouped as follows:

1. The cases operated upon between 1890 and 1895 were not

benefited by the operation; 8 cases, 11 hips, no death followed the operation. (Two deaths occurred, one from scarlet fever and one from cholera infantum, some months after the operation.)

2. Those cases (19, 23 hips) between 1895 and 1898 show a small percentage of successful reduction, with one death from shock on a double operation, radical, on too young a child—one year old. (An unjustifiable procedure and a preventable death.) Eighteen cases, 15 single and 3 double; of these 3 hips were firmly replaced by operative reduction (as proved by the X-ray). One was not heard from after leaving the hospital. In 4 hips, 3 cases, there was improvement; in 8 cases, 9 hips, there was improvement, but the head was not firmly in place. In all these bloodless reduction was first performed, with a relapse. In 4 hips bloodless reduction was tried, with a relapse in 3 cases; in 1 the reduction has seemed permanent. In 1 of the above-mentioned cases death took place from whooping-cough a month after successful radical operation on one hip, but before the radical operation on the second hip, both having been reduced by the bloodless method, with relapse. The pathological specimen shows firm reduction in the operated side.

3. Cases operated upon in the last year, 1899–1900, with improved technical experience: Seven cases, 10 hips, all reduced first with bloodless operation, and all relapsed; of these 9 operated upon again by radical reduction with incision. Four hips were firmly replaced, as shown by X-ray; two hips firmly replaced, but no X-ray as yet secured; 1 apparently reduced by X-ray photograph; 2 relapsed after radical operation; 1 relapsed after bloodless reduction without attempt at radical reduction.

In a recent case of single congenital hip location Allis' method of reduction of traumatic dislocated hip was tried, and the reduction was made with unusual ease.

DISCUSSION.

Dr. V. P. Gibney, of New York, said that the Association should feel greatly indebted to Dr. Bradford for this wonderful specimen. His lucid demonstration of the acetabular pouch and folded capsular ligament made clear one of the causes of failure.

The suturing of the capsule so as to make the result lasting seemed to him a capital idea.

Dr. John Ridlon, of Chicago, said that he had had six or eight successful cases done by the bloodless method during the past few years. They had remained well for a year or more after all restraint had been removed. He had had some older patients also in which he had been in doubt about the complete replacement at the time of the operation, and had had that doubt removed by unquestionable relapse after operation. He had had one case in a child of about four years of age, whose mother has a double congenital dislocation, where he believed he had replaced the head in place a year ago, and where it seemed to remain in place during the three months that plaster-of-Paris had been applied. It had gone out of place as soon as the brace had been substituted. He believed it was more important to control the flexion than abduction. He felt sure that he had replaced it last fall, but it again relapsed. An X-ray picture showed that the head and neck of the femur were very imperfect. There was scarcely any head or neck. He was of the opinion from this meagre experience that if the patient were young, and if the head and neck were fairly well developed, it was possible to replace it by the bloodless method and to retain it. In older cases this was not possible, for the reason just pointed out by Dr. Bradford; but whether young or old, if the head and neck were very slightly developed, the improved position could not be maintained. He did not believe it was possible by the bloodless method to replace and retain it unless very considerable abduction was maintained permanently, and absolute control over both passive and active flexion. In his experience with these cases the head had gone out, not because the extreme abduction had been lessened, but because the leg had been allowed to be flexed by imperfect apparatus or by a plaster splint which had not fully covered the buttock.

Dr. Harry M. Sherman, of San Francisco, said that in all of the cases in which he had tried the bloodless method and had succeeded in placing the head of the bone on the acetabulum, but not in it, the head had slipped away with one exception. This last case would probably prove successful if the child survived a vertebral

tuberculosis which has developed. Where he had passed his finger down into the acetabular pocket he had been struck with the fact that the opening into the pocket was exceedingly small—so small that it would decidedly pinch the finger when so introduced. He had been in the habit of slitting this pocket with a bistoury down to the bottom. He had tried suturing in one or two instances, as suggested by Dr. Bradford, but had become convinced that he was not suturing accurately, as the incision was not sufficiently long, and none of the suturing could be done by sight. He believed that the position of the head between the two lateral halves of the pocket would separate them, and that they would lie upon the head in a position quite as stable as if they had been sutured. The long, thin upper portion of the capsule he had allowed to remain to collapse and adhere by itself. In every one of these cases the head of the bone had remained in place. This pocket, therefore, was a very definite obstacle, which could be appreciated in the open operation. Most of his cases had been subjected to X-ray examinations, both before and after operation, to show definitely the position of the head, and the children also showed by their walk that the head of the femur had a fixed place.

Dr. H. P. H. Galloway, of Toronto, asked Dr. Bradford how long after the cessation of treatment by the bloodless method relapse usually occurs. He had himself attempted this operation on six or seven hips, and most of them were still under treatment. In one of these cases—a child with both hips dislocated—there had been apparently a perfect cure of one hip. The child had been photographed before attempting treatment of the second hip, when, without being conscious of it, the little one had stood by preference on the hip which had already been reduced.

Dr. Bradford, in reply, said that he could not speak quite as definitely as some of the German writers, who had perhaps employed the bloodless method more than he. All of his own cases had relapsed after the bloodless method with one exception. It was not easy to determine accurately, without a skiagram, whether or not the head was in its place. He claimed that the bloodless method was one which had been introduced because of the ease with which

it could be done; yet it seemed to him that this method sacrificed precision to the timidity of the patient. At first his open operations had been quite severe, but more recently he had met with no difficulty in securing ready healing by first intention. He was more strict regarding aseptic precautions in this operation than he would be in an ordinary laparotomy. It certainly did at first seem, as Dr. Sherman had said, inadvisable to suture the capsule because of the difficulty of the procedure, but increasing experience had diminished this difficulty. Lorenz had used an oblique incision from the anterior superior spine to just below the greater trochanter, avoiding the muscles. Dr. Bradford said he had at first employed this incision; but, as it did not give enough room below, he had in his later operations made a straight incision from the greater trochanter to two or three inches below or just above the insertion of the gluteus maximus. At the upper end the incision was curved slightly upward, between the tensor vaginæ femoris and the gluteus medius. He first exposed the lesser trochanter, and with the periosteum elevator he pressed up the insertion of the psoas and iliacus muscles. He next opened the capsule and made a cross incision on the capsule, anteriorly and posteriorly. The finger was then inserted into the acetabulum. It was necessary that all of the contractions of the soft parts be overcome. He usually did this by a preliminary stretching or by an open incision and myotomy. After reduction the parts were kept immobilized for three or four weeks, and if then the head did not seem to be firm, he cut down and sewed it in. Regarding what Dr. Ridlon had said about deformities of the head, he would say that this operation could not, of course, be done successfully except in the early stages. At present he felt that he could not operate successfully on patients over six years old.

AN OPERATION FOR UNUNITED INTRACAPSULAR FRACTURE OF THE NECK OF THE FEMUR.

By GWILYM G. DAVIS, M.D.,
PHILADELPHIA.

In the Transactions of the American Orthopedic Association, 1898, vol. xi., p. 241, Dr. Arthur Gillette describes an operation performed by Dr. Edward Boeckmann and himself for ununited fracture of the neck of the femur. It consisted in raising a large horseshoe-shaped flap from over the outer side of the hip, sawing off and raising the greater trochanter and entering the joint from above. The bone was freshened and an ivory peg driven through the neck into the head. The trochanter was then brought down, fixed by another ivory peg, and the flap sutured in place.

In the discussion which followed the reading of the paper, Dr. R. H. Sayre stated that he had operated on one case by making an incision as for excision of the hip, and then, after freshening the ends of the bone, had pinned them together with a gimlet and two nuts. Parkhill has also suggested a modification of his well-known clamp for the same purpose (*Annals of Surgery*, May, 1898, p. 556). The operation here proposed and done in the two cases detailed I believe to be both easier of performance and less dangerous to the patient than those just given.

Case I.—In the summer of 1899 a man, aged thirty-eight years, was referred to me by Dr. John Fay, of Altoona. While unloading a heavy log from a wagon the skid broke and the log fell on his foot, crushing the left ankle, and also knocked him down and struck his right hip, producing an intracapsular fracture of the neck of the femur. I saw him one year later. He had never walked since the accident. The injury to the left ankle was completely healed, but

the joint was ankylosed with the foot in a slightly extended position. The right hip was the seat of an ununited fracture of the neck of the femur. Pressure on the foot caused the trochanter to move up on the pelvis, and drawing on the leg caused it to move down. Its top was well above Nélaton's line, at least four centimetres. He was admitted to St. Joseph's Hospital under my care, and the following operation performed:

Operation. An incision five inches long was made downward, in the long axis of the limb, from just below the anterior superior spine of the ilium. The fascia lata was incised, the tensor vaginæ femoris muscle pulled outward, and the sartorius and rectus femoris muscles pulled inward. This exposed the anterior surface of the capsule of the joint. This was incised and sufficient of it removed with scissors to gain free entrance to the joint. By means of a gouge and sharp curette the two fractured surfaces were removed until fresh cancellous bone was exposed. A second incision four centimetres long was then made directly over the great trochanter on the external surface of the hip. Extension and counter-extension was made by assistants, and when the fragments were felt to be in apposition by the index finger of the left hand introduced into the anterior wound, two long steel pins or drills were pushed upward and inward through the posterior wound and trochanter for eight centimetres ($3\frac{2}{5}$ in.) up through the neck and into the detached head. The anterior wound was closed, leaving in a small tube for drainage. The pins were eleven centimetres long, three centimetres of which protruded beyond the skin surface.

On the second day the drainage-tube was removed from the anterior wound without removing the plaster-of-Paris dressing which had been applied at the time of the operation. The subsequent course of the wound for two weeks was uneventful. He then began to feel bad; his temperature rose to as high as 105°, and fell again to about 99°. He had chills, fever, and sweats, and it appeared as if he had pyæmia. The sutures in the anterior wound had been removed on the tenth day, leaving it firmly united by primary union. Thinking that the high temperature might be caused by joint infection, I took a straight bistoury and sunk it directly downward through the healed wound until it struck the neck of the femur near the head. As nothing followed this puncture, my attention was then

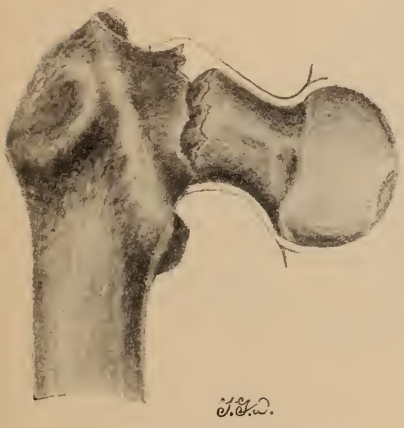
directed to the small posterior wound, from which the ends of the steel pins still protruded. The pressure of the pins had caused the skin to ulcerate, and there was some pus in the wound. The pins themselves were found to be loose, so that both were removed and the wound carefully washed out and disinfected. This was about the end of the third week. When symptoms of infection began the plaster-of-Paris bandage was entirely removed. It was found that some attempt at union had taken place, although a little movement could still be detected. Extension by means of a weight and adhesive plaster was then applied as used in ordinary cases of fracture of the femur. Over the dressing covering the wound a circular bandage binding the hips together was placed, and over this an elastic bandage, and later an ordinary Petit's tourniquet. The object of this was to press the hip inward, so as to maintain as much as possible the two freshened surfaces of bone in contact. To prevent the trochanter falling backward, a small sand-bag was placed beneath it. Improvement was manifest almost at once. The chills, fever and sweats soon stopped, and convalescence from this time was uneventful. In about ten weeks from the time of operation he was discharged, with, as far as we could determine, firm union, normal movements of his joint, except a slight decrease in the amount of abduction, and with his operated leg not giving way in the slightest when he rested his weight upon it.

Case II.—Six months later another case came under my care. It was that of a man aged thirty-five years. He was subject to epileptic fits, and during one of these he fell on his hip. He was brought to the hospital, and, while no fracture could be detected by means of the X-rays, he was treated with sand-bags and extension. Six months later I found him still using crutches and unable to bear any weight on the limb, it being totally disabled. He had all the signs of an intracapsular fracture, eversion of the foot was marked, and there were four centimetres of shortening. On resting his weight on the affected hip it could be felt to slide upward. The same incision was made as in the previous case and the fractured surfaces freshened. Another incision was then made over the great trochanter and two holes bored through the compact tissue. Two ivory pegs eight and a half centimetres ($3\frac{2}{5}$ in.) long were then

driven upward and inward through the trochanter and neck into the detached head of the femur. While this was being done extension and counter-extension was kept up, and the greater trochanter, which had a tendency to fall backward, was pushed forward. A small drainage-tube was inserted, the wounds closed, the posterior ones without drainage, and a plaster-of-Paris dressing applied from the waist to well below the knee.

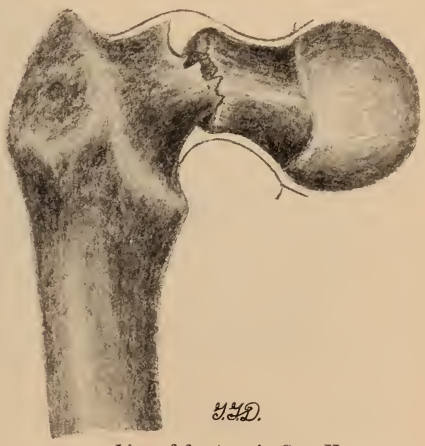
The tube was removed on the second day. On the fifth day the temperature was normal, and remained so. On the ninth day the stitches were removed, some serum escaping at one spot, which closed immediately after, and the wound was firmly healed. He had some

FIG. 1.



Line of fracture in Case I.

FIG. 2.



Line of fracture in Case II.

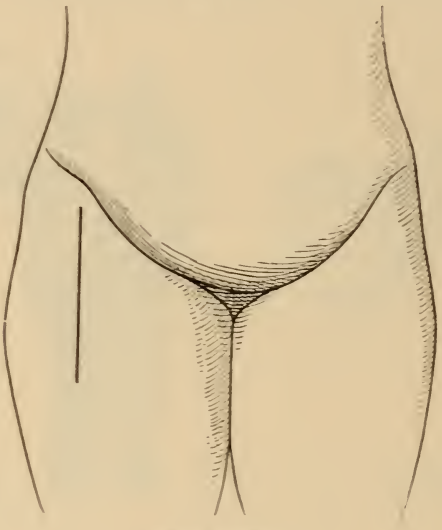
fits after the operation. Since being out of bed he says his knee is weak. He had a Chopart amputation previously performed on the foot of the affected side This, with his weak knee, makes him as yet a trifle unsteady, but he can walk with the support of a cane. He says his hip is all right and strong, and that he has no pain, and it does not yield when his weight is put upon it. It is mainly the weakness of his knee which prevents him walking without any support. There is now less than two centimetres shortening, and the movements of the joint appear to be normal.

The direction of the fractured surfaces in these two cases was somewhat different. In the first case (Fig. 1) the line of fracture

in front extended almost parallel to the intertrochanteric line and just above it, being, of course, inside the attachment of the capsule. From this point it ran backward and inward. The line of fracture in the second case (Fig. 2) ran from above the great trochanter inward and downward to the lower portion of the junction of the neck of the femur with the head. The capsule remaining attached to both the femur and pelvis limited the amount of displacement.

In considering the method of approach to the site of fracture for operative purposes, the straight incision down from the anterior

FIG. 3.

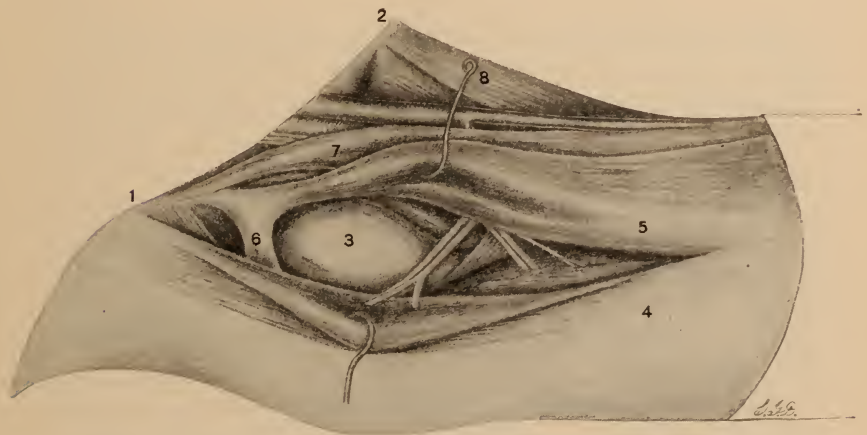


Line of incision.

superior spine of the ilium gave sufficient exposure without the necessity of cutting a single muscle (Figs. 3 and 4). It is not even necessary to make a transverse division of the fascia lata. By refraining from going too far down, no large bloodvessels or nerves are cut. An ascending branch of the deep external circumflex artery may be divided, but it is easily secured. Through this incision the capsule of the joint can be freely opened on its anterior surface between the two arms of the Y ligament. The opening in the capsule should be of sufficient size to permit the free entrance of the index finger and the use of instruments. This will not

seriously impair the usefulness of the ligament, because the two branches, one extending toward the greater and the other toward the lesser trochanter, are but little encroached upon. No attempt need be made to close the opening in the capsule. Using steel pins and allowing them to protrude nearly caused a fatal issue in the first case, and has disinclined me to employ any method of fixing the bones that entails an open wound leading from the surface of the skin directly into the bone. There was no infection in this case from the anterior operation wound, because that had firmly healed

FIG. 4.



1. Anterior superior spine. 2. Spine of pubis. 3. Neck of femur. 4. Tensor vaginæ muscle. 5. Rectus femoris muscle. 6. Its reflected head. 7. Sartorius muscle. 8. Adductor longus muscle.

by primary union, but it did occur from the suppurating track of the pins. The use of ivory pins in the second case, which were driven entirely in and allowed to remain, was more satisfactory; whether they will ever give rise to trouble in the future remains to be seen. Probably a still more efficient way to fix the fragments would be to use a large silver-plated wood screw. By means of it the fragments could be brought still better in contact, and I am inclined to try it if another case presents for treatment.

THE TREATMENT OF SCOLIOSIS DURING NIGHT REPOSE.

By OSCAR VULPIUS, M.D.,
HEIDELBERG, GERMANY.

The interesting observations which Fitz has brought before our notice in the eleventh volume of Transactions concerning the influence that a recumbent position has upon the spine give rise to an important train of thought. Following this, I have endeavored to use the hours of the night for the cure of scoliosis.

The evil effects arising from sitting and standing in wrong positions have been considered and blamed as the principal origin of spinal curvature. In the standing position, faulty posings of the leg must come into consideration, quite apart from an actual shortened leg, because a wrong position may seem to make one leg shorter than the other.

Whether it is that the physiological genu valgum of girls makes a normal position of ease difficult, or that the effort made to relieve the weight on one leg causes it to become pushed forward and bent, or whether it is simply an unconscious tendency toward a graceful position—in any case, this habit of adopting an "attitude hanchée," and the standing position of the pelvis connected with it, can certainly produce an habitual bending of the vertebral column.

It is equally evident that long standing and the consequent strain on the muscles of the back, which are so susceptible to fatigue in rapidly growing girls, may produce a similar sideward curvature of the spine.

The harmful effects of sitting a long time in a bad position are also well known, and have often been investigated and discussed.

It is clear that a crooked attitude, both in standing and sitting, easily leads to a bony fixation of the lateral curvature resulting from the abnormal pressure.

As the weight of the human body ceases when it is in a recumbent position, it has been assumed that the attitude in lying and the force of the attitude are matters of smaller significance in the origin of scoliosis. In my opinion, and according to the observations which Fitz has made, this is a very wrong assumption.

The deforming power which the weight of the body, in a bad standing position, has upon the spine is certainly very much more pernicious in its effects than an unnatural and wrong attitude in lying could be. But the harm caused by the unnatural recumbent position during a greater number of hours of repose is much worse, because the influence of the bad position has the whole night to take effect in.

Now, an habitually crooked attitude during repose can lead, in course of time, to a shrinking together of the concave-sided soft parts and an expansion of the converse-sided soft parts, and, further, can lead to an asymmetrical growth of the vertebræ.

This hurtful influence may be without effect on healthy persons, but where people with soft bones who are inclined to scoliosis are concerned, and more especially where scoliosis is already apparent, this harmful influence must be of importance and should receive careful attention.

Mothers of scoliostic girls are constantly drawing our attention to the fact that these children have the habit of lying "rolled up in a ball" in bed.

Fitz's investigations have greatly strengthened the supposition that this has a pernicious influence on the origin and development of spinal curvature.

Even if the anamnesis of only eight cases shows that the habitual position of the body in bed coincides with the form of the scoliosis the proof is amply sufficient.

Therefore, on the strength of such considerations and experience, we must bring about a straight attitude of the back in lying where our scoliostic patients are concerned; not only for prophylactical reasons, but also in the interests of therapeutics.

How this has been accomplished for nearly two years in our hospital with regard to our treatment of scoliosis shall be briefly described in this communication.

Our scoliostic patients are strictly bound to a daily routine which

consists of hours for treatment in the gymnastic hall, with pauses for repose and relaxation.

The patient goes to bed at eight o'clock. The footboard of the extending bed can be placed horizontally, and has sliding rollers. At the head of the bed are straps with closed hooks, in the form of a swivel, to which the head bandage is fastened by means of rings.

The extension catches on to an upholstered abdominal strap, and the cords bearing the weight run from the strap over the rollers.

It is more effective to let the extension catch on to the pelvis rather than on to the legs, so that the stretching force may be centred as much as possible on the spine. Indeed, patients tell us that in our arrangement of the extension the stretching is felt in the lower part of the spine. Toward the upper part the strength becomes exhausted through the friction of the body on the couch.

Therefore, if the scoliosis is in the upper part of the spine, we should get at it more easily if we fixed the body lower down, letting the extension be attached at the head of the patient. And, as the cervical part of the spine must, therefore, support the greater part of the extension, we have tried to localize the effect of the extension, according to wish, in a manner afterward to be explained.

The weight extension, therefore, first of all, brings about a straight position of the spine. But it does more than this. It not only removes the coil effects caused by a bad attitude during repose; it also influences in a favorable and curative manner the already existing lateral curvature. It has a therapeutical as well as a prophylactic effect.

In these days the stretching-bed has long been consigned to the lumber room. One has accustomed one's self to believe it useless and objectionable.

This depreciation is very likely dependent on the introduction of massage and gymnastics for the cure of scoliosis. An exclusive use of the stretching-bed may well be despised, but there is no reason why it should not be used to help as a support for hours of rest, especially for night rest.

We are then fighting against at least two forms of the complex symptoms of scoliosis. These are: Lateral curvature of the spine and lateral displacement of the body.

To influence a third symptom of scoliosis—*i. e.*, torsion—as well as to support the effect of the extension, we have combined the extension with the position in a plaster-of-Paris bed.

The latter is arranged in the following manner: After the spine has been, to some degree, mobilized by the gymnastic treatment, the patient, clothed in tight-fitting, thin stocking-net costume, is placed face downward on the operating-table and stretched out horizontally in the manner I have recommended for the Calot method.

The head is fixed at the top of the extension of a large screw fastened on to the legs by means of silk cords.

Without being too strong, the extension produces a stretching of the spine; the waist becomes equal on both sides, and at the same time results in the desired easy lordosis of the back.

To produce detorsion a cushion is pushed under the concave-sided half of the back. Now, the bed is made with plaster bandages running longways and crossways. It must be very exactly modelled, and must be made specially tight-fitting over the hips.

The bandage is made stronger by bands of zinc, or wooden splints, and reaches from the neck to the middle of the thigh, and encircles the body about half-way down. When it is hard enough the plaster dressing is taken off, together with the stocking-net, which is cut in front and is placed, after being dried, on a wooden stand in the workshop.

Shoulder straps are brought to fasten the patient in the plaster-of-Paris bed. On the side of the torsion a felt cushion is placed in order to intensify the pressure, and at the same time to facilitate a twisting back of the concave side.

When the patient has been brought into this position and extended in the manner I have just described, the principal strength of the extension will be felt in the lumbar of the spine and in a less degree toward the top, on account of the friction.

In order to remove the friction the plaster bed is placed on a sliding-board. The latter carries six rollers fixed in the board and sufficiently large to make the sliding movement possible. Guiding straps prevent the sideward sliding of the plaster bed.

In this arrangement the extending effect will be strongest on the upper part of the spine.

In order to bring the extension to correspond with the top of the

curvature in middle dorsal scoliosis, and, further, in order to prevent the extension from becoming burdensome to the top part of the spine, the plaster-of-Paris bed can be divided as the illustration

shows. The upper part is screwed fast to the sliding-board; the lower part rolls.

It is clear now that the greater extension power must be localized at the place of division. A little break arrangement is contrived to prevent the two halves from knocking together, so that the skin

may not be squeezed between them. The detorsion cushion must, of course, be divided in such a case.

The power of the extension naturally differs according to age, size, and weight of the patient, somewhere between eight and eighteen pounds.

The extension is begun carefully and the strength is increased by degrees; it must, as a matter of course, become less if the friction is lessened by the sliding-board. This mode of extension allows a much more accurate dose of the extending power, which can be better localized and which can be borne for a much longer time than is possible with the vertical suspension.

Patients generally become quickly accustomed to sleeping upon the back in a full-length position, and remain at least the greater part of the night in the plaster bed and the extension, but they can free themselves at any time from the extension.

That the night's rest, and with it the general health of our patients, is not disturbed by this use of the night for therapeutical causes is proved to us by their improvement in health and their increase in weight, which, we have observed, takes place regularly and sometimes in a most surprising degree.

After we have confirmed, by the practical experience of nearly fifty cases of scoliosis, these suppositions, which led to the construction of our couch apparatus, we do not hesitate to recommend it for the use of and as the means of great assistance in the wearisome struggle against scoliosis.

WHAT IS THE EXPLANATION OF THE WASTING OF THE LIMB IN DISEASE OF THE HIP-JOINT?

By EDMUND OWEN, F.R.C.S.,
LONDON, ENGLAND.

If in the course of the examination of a medical student or of a young practitioner I ask what is the explanation of the wasting of the limb in tuberculous disease of the hip-joint, he promptly replies, "Want of use," and he seems to be perfectly satisfied that his answer leaves nothing to be desired; in fact, he *knows* that what he says is correct. But, as the old doctor remarked in *The Fool's Paradise*, "Knowledge is the monopoly of the young practitioner," and as he grows older it may become forced upon him that there is some other factor in the wasting than mere want of use.

At least I am by no means satisfied that the theory of want of use fully answers the question with which I preface these remarks. I am quite prepared to admit that when a child is laid up in bed from any cause a certain amount of general muscular atrophy takes place because of want of use. Thus, on the very day on which I write this sentence a boy from whose right knee I had removed a loose semilunar fibrocartilage, after having lain ten days in bed, called my attention to the fact that his sound leg was getting small. I dare say that it was. But the wasting to which I refer is something far more noteworthy and important than this. It is an atrophy of bone as well as of muscle affecting the limb with the tuberculous hip-joint.

The term *atrophy*, used in its widest sense, means want of nourishment, and may thus be applied to a tissue of which the development is arrested as well as to one which, though previously well developed, has now begun to waste. In the case of chronic joint disease atrophy affects the limb in both of these senses. Muscles which were once properly developed dwindle away to nothing, and

the bones involved in the affected joint fail to attain their proper size. The latter of these effects may be best observed in the case of old-standing tuberculous disease of the hip-joint. Though the head of the femur remains in its socket, the great trochanter does not project so far as on the other side (allowance being made for the muscular wasting), and it is above its proper level, showing that the neck of the femur is shorter than it should be. And careful measurement reveals the fact that the entire limb has not attained its due length. Moreover, if a shadow picture be taken, the upper end of the affected femur is shown to be more slender than that of the other side. This is not the result merely of want of use, for in the case of a child who has been lying on his back—perhaps on a double Thomas splint, for instance—for nearly the whole of the time that his hip has been diseased the affected limb is conspicuously wasted, but the other hardly at all.

I think it fair to assume that in the case of chronic tuberculous disease of the hip-joint the atrophy of the muscles, which is shown by their extensive wasting, and the atrophy of the femur, which is evinced by its failure to attain proper development, are due to the same cause. What is that cause?

In the anterior cornu of the gray crescent of the spinal cord are large multipolar, trophic cells (trophic, τροφος nurse, τρεφειν to nourish), which preside over the nutrition of the muscles, bones, and joints. When, as in anterior poliomyelitis, these cells are seriously disturbed or actually wrecked, they are thrown out of working order and the tissues depending on them for their supply consequently suffer. And so it comes about that in infantile paralysis not only do the muscles waste, but the bones remain small and the joints lax.

In infantile paralysis, which is the *result* of anterior poliomyelitis, the muscles of the affected limb wither and the bones cease to grow. And all this is undoubtedly the direct result of the storm which has taken place among the trophic cells in the front of the gray crescent.

I am inclined to think that the wasting of the limb in hip-joint disease is the result of a similar though, of course, much slighter disturbance of the trophic cells in the gray crescent, brought about, probably, in this manner: When tuberculous disease is started in a boy's hip-joint, the only help that nature can render is by keeping

the limb and the joint at rest, and this she effects by diminishing the irritability and vigor of the muscles through a reduction of their supply of blood through the influence of the trophic cells. In amputating a limb for hopeless tuberculous disease of a joint, has not the surgeon often been surprised at the smallness of the main arteries which he has had to secure?

I feel safe in asserting that in chronic tuberculous disease of the hip the supply of blood to the muscles and, of course, to the bones as well is diminished.

The office of the trophic cells in the anterior cornu is to govern the nutrition of the limb in all and varying circumstances—in disease as well as in health. To accomplish this there must be harmonious working between the cells and the limb. If the cells are damaged, as in poliomyelitis, the muscles, the bones, and the joint suffer. And if the joint is in trouble, as in tuberculous arthritis, are the trophic cells to remain unimpressed, unsympathetic? I think not. On the contrary, I opine that these cells are at once made aware of the articular inflammation, and that they forthwith set to work to inhibit the wonted arterial flow in order that the affected parts may be rested to the utmost, and so it comes about that wasting of the limb sets in.

With our present methods of pathological investigation it may be impossible to demonstrate the existence of molecular disturbance in the anterior cornu of the gray crescent of the lumbar enlargement in the case of a child dying from chronic tuberculous disease of the hip-joint. Possibly it has not hitherto been looked for. But as methods improve and our powers of observation advance, I expect that such histological changes may become clearly demonstrable. And, if so, the question which heads this short paper will be finally and completely answered.

THE TREATMENT OF DUPUYTREN'S CONTRACTION OF THE PALMAR FASCIA BY THE OPEN METHOD.

By A. H. TUBBY, M.S. Lond., F.R.C.S. Eng.,
LONDON, ENGLAND.

Many years ago the open method of treating contraction of the palmar fascia was practised by Goyrand and others, and various incisions were planned and carried out. But the method was abandoned, probably on account of the suppuration which followed a wound of the palm in those septic surgical days—suppuration which led not only to a serious crippling of the hand but also, in some cases, undoubtedly, to an entire loss of its use. The subcutaneous operation carried out by the late William Adams, and perfected by him, gives in competent hands admirable results except in three points, namely, the possibility of recurrence with extension to other fingers, the necessity in severe cases of operating in stages, the length of after-treatment and the expense of the apparatus required. It was on these grounds that after practising Adams' operation I have, more especially in hospital cases, adopted the open method. The main objection to it is now removed by the aseptic methods in vogue, and primary union with accurate junction of the edges and a free and supple palm can certainly be secured. The liability to recurrence is greatly lessened, for by a free dissection all the affected parts can be removed, and with regard to apparatus, a simple malleable iron splint, bent or straightened as the case requires, is all that is needed. As a rule, the wound is healed in two or three weeks and the hand regains its entire functions.

The essence of the whole operation is complete asepsis from first to last, and no precautions should be relaxed until every scab has come away from the wound. One of my cases nearly came to grief

through disregarding my injunction in this particular. He was a Lloyd's surveyor, who was compelled to return to his duties just before a small scab about one-eighth of an inch in diameter had separated from the wound. He had been told to keep the palm covered with an aseptic dressing until this had been effected. But he disregarded my advice and swarmed up a rope with his tender palm and knocked off the scab. Acute œdema without suppuration, however, followed, and did not subside for some weeks. Ultimately it all disappeared, and the final result is perfect. This case serves to emphasize how susceptible any lesion of the palm is to septic influences, and thus the most carefully planned and executed operation in this region may be marred by a little undue haste and want of caution. To avoid every possibility of septic trouble the sterilizing process of the hand should extend over about two days before the operation. The surgeon should attend to all the details himself. As a rule, I find it suffices to scrub the hand and forearm well with soft soap, then with turpentine, then with ether, and, finally, to keep it bound up with 1 : 1000 solution of biniodide of mercury. It is only in this way that the hardened hands of operatives can be cleansed. Of course, all the usual precautions are taken as to the surgeon's hands and instruments. The writer must ask some indulgence in dwelling upon this point, but he does so with the definite object of enforcing the statement that the keynote of this operation is asepsis first, asepsis second, and asepsis even to the last scab.

In conducting a delicate dissection in the palm an Esmarch bandage is useful, as the parts bleed freely from numerous small points, and so the dissection is obscured. The operation should consist of two parts when there is considerable contraction of the fingers, namely, the open method for the palm and the subcutaneous method for the latter. It is not, as a rule, advisable to attempt to remove by dissection the contracted bands of the fingers, more especially at the transverse folds. If the skin here be freely divided considerable gaping of the wound follows, cicatricial tissue forms, and a good deal of loss of mobility results. Even when nodules are present at the sides of the fingers the subcutaneous method, if sufficiently numerous punctures are made, answers well; and very numerous indeed the punctures must be in severe cases. It might be thought that skin-grafting would avail to fill the gaps at the

crease of the fingers. But this method is not admissible, as it is necessary to extend the fingers shortly after the operation if perfect mobility is to be secured, and the skin grafts will be displaced.

For the contraction in the palm a straight incision from just below the situation of the superficial palmar arch to nearly as far as the webs of the fingers is made right over the most prominent band of fascia. If the implicated fascia is of wide extent two cross incisions may be made, one at either extremity of the longitudinal incision. The flaps so made are dissected back, leaving the indurated fascia exposed. The digital nerves issuing from beneath the palmar fascia are then sought for and carefully defined. Without much further trouble the whole of the affected fascia in the palm can be dissected away, and the dissection must be a wide one. Care, of course, is taken that the vessels and nerves are not wounded. The arrest of hemorrhage after the removal of the Esmarch bandage is best done as follows: The larger bleeding points are seized by Spencer Wells' forceps and twisted, and the smaller bleeding spots are arrested by the pressure of a hot sponge. Silk or other ligatures are to be avoided, as they are apt to give rise to trouble in the palm owing to non-absorption. Complete arrest of hemorrhage is a point of some importance. If the skin flaps be sutured together and oozing still be going on, a good deal of thickening results after the operation, which is undesirable. After the removal of the affected fascia in the palm the fingers can be in all cases considerably straightened, but further extension can be obtained by multiple minute subcutaneous punctures of the extensions of the fascia on the lateral aspects of the digits. In suturing the palm wound very careful adjustment of the edges should be made, and the best material is fine horse-hair. The hand is then dressed and the metacarpus and the affected fingers are secured immobile by a malleable iron splint extending from above the wrist to the tips of the affected fingers. The dressing is left *in situ* for at least six days, and then the wound will be found fairly well healed. Some gentle passive movements of the fingers can be made and the hand redressed. On the eighth or tenth day the stitches should be removed, the hand by this time having been brought to the fully extended position. A collodion dressing is now all that is necessary. This is kept on until the wound is absolutely healed and there is no crack at all in the skin.

The following cases may be referred to:

A. G., aged forty years, a coach-builder by trade, suffered from Dupuytren's contraction in both hands. The ring and little finger of the right hand were affected, the tip of the little finger being nearly down on the palm, and the ring finger being nearly as much flexed. On the left hand the little finger was also flexed considerably. In both palms the contracted bands were prominent. There was no history of gout, but the patient's occupation necessitated considerable pressure of the palms of the hands in the use of his tools. There were no nodules either in the palms or in the fingers. He was an eminently suitable case for operation by the open method, and he could not afford to lie up for long; he was perfectly healthy, and the contraction was by no means extreme. The operation was performed and the fingers were straightened at one sitting. In fourteen days the palms were healed and he returned to work in three weeks, wearing a leather protector to the palms.

Another case was that of A. X., aged sixty-four years, an army veteran, but employed as a clerk for the last ten years. An interesting point about his case was that he had suffered from constitutional syphilis and still had squamous syphilides in the palms of the hands. There was no history of gout in his family. The contraction affected the fourth and fifth fingers of the right hand, but it was also commencing in the left hand. After a course of antisyphilitic treatment, during which the squamous syphilides disappeared, the open operation was performed, and the case did extremely well with the exception that some thickening remained beneath the scar, which disappeared six weeks after the administration of ten grains of iodide of potassium three times a day.

A third case was that of the Lloyd's surveyor mentioned above, whose right hand was affected, the palmar fascia opposite the fourth and fifth fingers being tense, with the fingers slightly flexed, there being about thirty degrees of flexion at the metatarsal phalangeal joints. The affected fascia was dissected out, and the case did very well until close upon its termination, when he rubbed off the scab, and acute œdema followed, with some stiffness of the fingers, which

only disappeared after several weeks. The hand, however, entirely regained its mobility.

There can be no doubt that by this method excellent results can be obtained, but the cases should be chosen carefully. Extreme cases are not suitable on account of the contraction of the skin and its close adhesion to the fascia, with the resulting gaping when the fingers are straightened.

Again, these cases do not bear sudden stretching, as the tension on the nerves is too great. Neither should broken-down patients, either of renal or cardiac character, be submitted to the operation, nor should cases too far advanced in age. But, with these exceptions, it certainly seems that aseptic surgery has enlarged considerably the field of operation for Dupuytren's contraction of the palmar fascia, and is a great economizer of time and trouble.

ADJUSTABLE BALL-BEARING JOINT.

By ANSEL G. COOK, M.D.,
HARTFORD,

I WISH to present for the consideration of the Association a splint having a ball-bearing joint so constructed as to have free lateral motion.

There is submitted herewith a full-sized drawing illustrating the splint. In this drawing Fig. 1 represents a plan or face view of the splint and joint.

Fig. 2 is an edge view of the splint, with the parts adjacent to the joint cut in central section to show construction.

Fig. 3 is a view of the two bars shown as separated.

Fig. 4 is an edge view of the parts shown in Fig. 3.

Fig. 5 shows in detail the pivot, cone, and cap or pad.

As illustrated in the drawings the letter *a* represents the longer bar, and *b* the shorter bar of the splint. Each of these bars is enlarged at its adjacent ends as shown in Figs. 1 and 3 of the drawings, an opening being made through each of the bars. The wall of the opening through the longer bar *a* has a circumferential groove of V-shape in cross section, forming a ball case for the balls, *d*. A pivot, *c*, extends through the openings in each of the bars. This pivot is headed at one end, and is screw-threaded at the opposite end. The head on its under side is formed to co-act with one of the walls of the ball case, and a cone, *e*, fits the screw-threaded part of the pivot and is formed to co-act with the opposite wall of the ball case. The under side of the head of the pivot and the cone form a double cone, the bearing being one known in the art as a four-point bearing.

The opening in the bar *b* is screw-threaded to fit the screw-threaded part of the pivot, this bearing forming a lock to hold the cone *e* in proper position of adjustment. A cap or pad, *f*, is secured

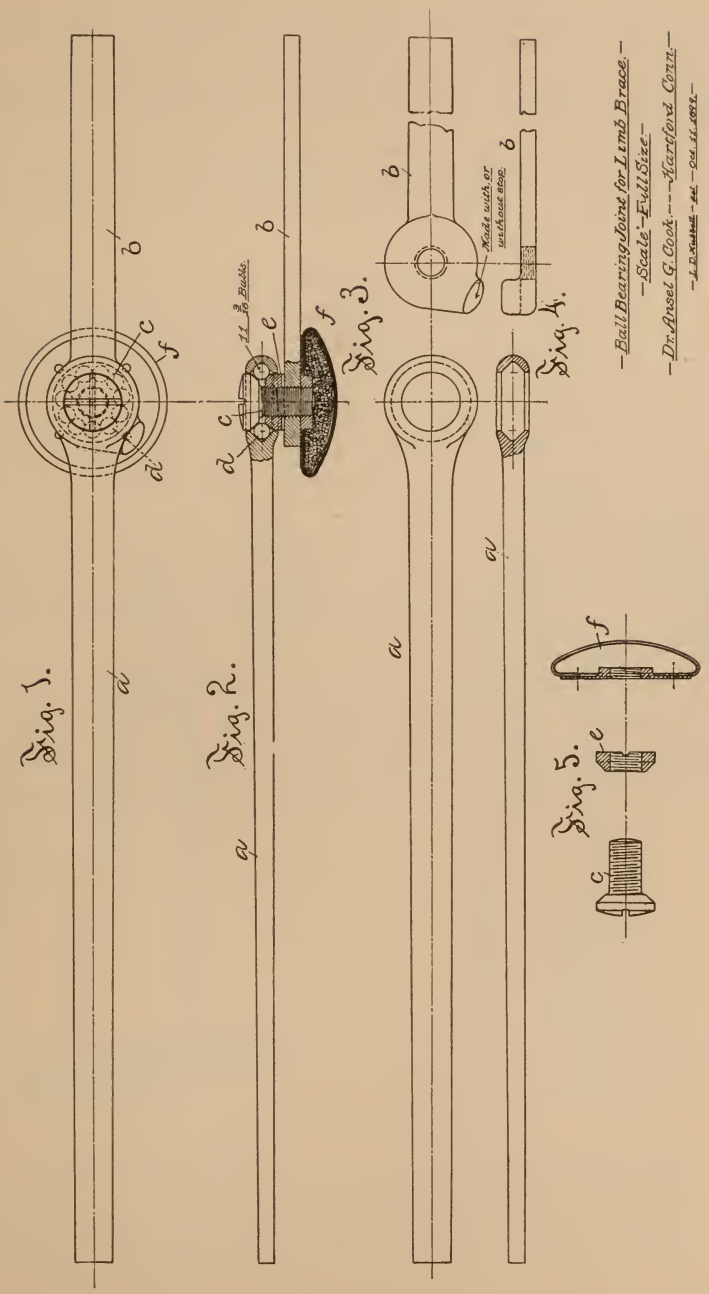


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Ball Bearing Joint for Limb Brace.
Scale. Full Size
Dr. Ansel G. Cook. Hartford Conn.
Made with or without stop.

to the outer threaded end of the pivot, completely covering the same and also forming a supplemental lock to hold the bar *b* and the cone *e* in proper position to allow free movement of the parts composing the joint.

These bars are made of steel, non-elastic, and capable of being bent to any desired shape to fit the contour of the limb, while the ball cases and bearings at the joint are of hardened steel to provide the greatest durability.

A joint made as shown in these drawings is simple in construction, durable, and noiseless; the parts are easily adjusted to permit free and easy movement, and are so assembled that the single drop of oil required once in about two years cannot escape.

I have recently examined four of these joints that have been in constant use for eleven months on a leg brace. They have never been oiled, adjusted, or regulated in any way, and they appear in as perfect condition as when new.

A splint provided with this improved joint is particularly appreciated by patients afflicted with chronic troubles and who have been annoyed by rattling braces, frequent visits to the instrument-maker, and oil-stained clothing.

It is not claimed that the joint in its broad application is new, but the details of construction of parts making up the joint, and the adaptation of the ball-bearing used therein is new, as far as I know, and the first ball-bearing joint ever used in orthopedic appliances.

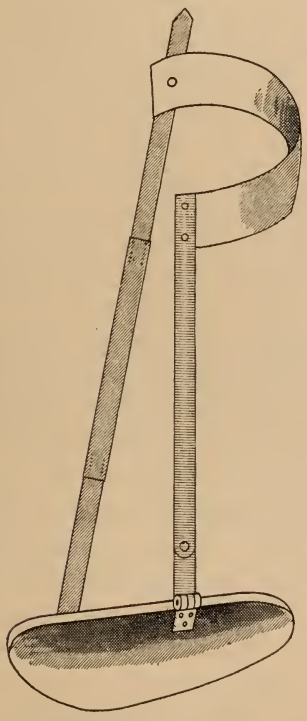
A SPLINT FOR THE TREATMENT OF EQUINO-VARUS.

By GWILYM G. DAVIS, M.D.,
PHILADELPHIA.

This brace is a device for applying continuous elastic traction in cases of equino-varus.

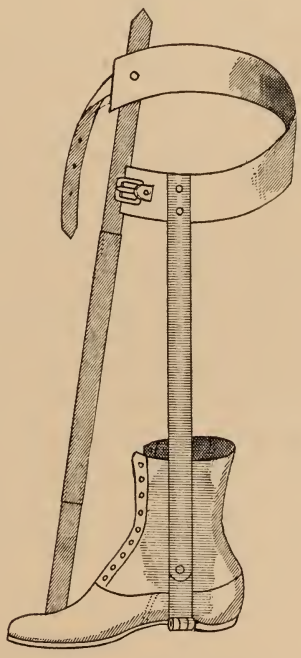
It consists of a sole plate, side iron, leg band, and elastic strap.

Fig. 1.



Splint for equino-varus.

Fig. 2.



Walking brace for equino-varus.

The sole plate is made of a piece of board the size and shape of the foot to be treated.

The side iron goes up the inner side of the leg. At its top is fastened the leg band. Opposite the ankle is a rivet which allows antero-posterior motion. At the junction with the sole of the foot is a hinge joint which permits lateral motion. We thus have motion in two directions: from before backward and from side to side. From the outer side of the foot piece an elastic band runs upward to be fastened to the leg band either on its outer side or at the top of the side iron on the inner side. In applying the splint the naked foot is placed on the wooden sole plate. They are firmly fastened together by bands of adhesive plaster. In some cases this is re-inforced by a plaster-of-Paris bandage which does not go above the ankle. The foot may also be first covered with a flannel bandage and then fastened to the sole plate with a plaster-of-Paris or rubber plaster bandage, as desired. The leg is then bandaged from the ankle up with a roller bandage. The elastic band being loose the side iron is brought up until the leg band fits around the upper part of the leg. The elastic band can then be brought up to make as much traction as may be desired.

The patient should be seen once or twice a week, so that any re-adjustment which may be necessary can be attended to.

The same brace can be used in a walking shoe, but in such a case an instep strap or inside lacing is added to keep the foot firmly applied to the sole.

It affords a convenient method of treatment after a case of equino-varus has been straightened, more or less thoroughly, by tenotomy or the application of plaster-of-Paris bandages after Wolff's method of allowing the bandage to harden while the foot is held as near as possible in a corrected position until the plaster is set.

The brace was devised to obviate the difficulties encountered in endeavoring to make traction by attaching the upper end of the elastic strap by means of adhesive plaster and plaster-of-Paris to the leg.

A STUDY OF SOME OF THE BONES AND JOINTS OF THE FOOT.

By JOHN DANE, M.D.,
BOSTON.

The description of the several bones of the human foot and their mutual articulations, found in the various anatomies and standard text-books, is such as to lead to the belief that, apart from differences in size and exclusive of conditions due to pathological changes, all feet are practically alike. Under the caption of variations, the possibility of a synostosis of two of the tarsal bones, the division of the internal cuneiform into two, or the presence of a supernumerary tubercle is sometimes alluded to, but in such a way as to make them appear as rare anatomical curiosities that have no practical importance.

The study of the conditions commonly classed as "flat foot," and especially the different results obtained by identical methods of treatment, led the writer to make further investigations in the hope of finding some differences in the shapes of the bones and their articulations that would account, in part, at least, for some of the differences met with clinically when the arch of the foot is supported by a more or less rigid plate. Through the kindness of Prof. Dwight, of the Anatomical Department, the material at the Harvard Medical School was made available for this purpose, two of the specimens here figured being generously contributed from his own private collection. The following tables represent, very briefly, the results obtained from an examination of 107 feet, preserved as osseous specimens, and the dissection of 70 more taken from subjects in the dissecting-room. In estimating the value of observations upon the disarticulated bones of the foot it must be remembered that it is practically impossible to tell the thickness of the cartilages and ligaments that were interposed between the bones; all measures can in

such cases be only approximate. Where an articular facette is seen on the bones we may be sure there was one in the cartilage as well; the converse, however, is not quite true, which leads to another distinct source of error. A full description of each foot has been omitted, the observations being confined to the region of the mediotarsal joint and that between the scaphoid and the cuboid, as these articulations would seem to be most apt to show variations that must have an important influence upon the mechanism of the foot when supporting the body weight. Unfortunately, many aspects of the problem were not seen at the beginning of the work, and, as a consequence, the notes, especially in the earlier part of the series, are not as full as could be wished, a loss which would not have happened if the admirable monograph published by Pfitzner,[1] in 1896, had been studied before the series had advanced some distance. Without doubt some variations escaped notice, because they were not specially looked for; the results, however, have been tabulated just as they were worked out—the two rare specimens added by Professor Dwight being excluded as not properly belonging to the series.

[1] Beiträge für Kenntniss des menschlichen Extremitätenskelets, vii. Die Variationen in Aufbau des Fusskelets. Schwalbe's Morphologische Arbeiten, Band vi., 1896.

TABLE I.—OBSERVATIONS ON 107 SKELETONS OF FEET.

No.	Scaphoid and cuboid.	Scaphoid and os calcis.	Astragalus and cuboid.	Curve of calcaneo cuboid joint.	Remarks.
1	Joint	?	Widely separate	Medium	
2	Joint	1/4 inch apart	1/8 inch	Marked	Cuboides secundarium joined to cuboid.
3	No joint	1/4 inch	1/4 "	Marked	
4	Joint	1/4 "	1/4 "	Marked	
5	Joint	1/8 "	1/4 "	Marked	
6	No joint	1/4 "	1/4 "	Very little	
7	No joint	1/4 "	1/4 "	Very slight	
8	Joint	1/8 "	1/8 "	Medium	
9	Joint	1/8 "	1/8 "	?	
10	Joint occupied nearly all surface	1/16 "	1/8 "	Very little	
11	Nearly all joint	1/4 "	1/4 "	Marked	
12	Large joint	Contact	3/8 "	Medium	Tibiale externum on scaphoid.
13	Joint	Contact	3/8 "	Medium	
14	No joint	1/2 inch	Contact	Flat	Structurally a flat foot.
15	No joint	1/8 "	1/8 inch	Medium	
16	Joint	? joint	1/4 "	Medium	
17	Joint	Contact	1/2 "	Medium	
18	No joint	1/4 inch	1/4 "	Marked	
19	Small joint	1/4 "	1/4 "	Medium	
20	Joint	Contact	3/8 "	Marked	Small strong foot.
21	Joint	1/4 inch	1/4 "	Medium	
22	Joint	Contact	1/4 "	Medium	
23	?	1/8 inch	1/8 "	Medium	
24	No joint	1/4 "	1/4 "	Marked	
25	Large joint	1/4 "	1/4 "	Little	
26	Large joint	1/4 "	1/8 "	Marked	
27	Large joint	Small joint	3/8 "	Marked	
28	No joint	1/2 inch	Large joint	Slight	Cub.secund. united with cuboid with a large joint surface for astragalus.
29	Large joint	1/4 "	1/4 inch	Medium	
30	Large joint	Contact	3/8 "	Marked	
31	Joint	1/4 inch	1/4 "	Slight	Osteophytes on several bones.
32	Small joint	? joint	1/4 "	Slight	
33	No joint	1/4 inch	1/4 "	Marked	
34	No joint	1/4 "	1/4 "	Medium	
35	No joint	1/4 "	1/4 "	Medium	Osteophytes on several bones.
36	Large joint	1/4 "	1/4 "	Medium	
37	Small joint low down	? joint	1/4 "	Marked	
38	Large joint	1/8 inch	1/8 "	Slight	
39	No joint	1/4 "	1/4 "	Medium	
40	Large joint	Contact	1/4 "	Marked	
41	No joint	1/4 inch	1/4 "	Extreme	
42	Small joint	1/4 "	1/4 "	Partial	
43	Small joint	Contact	3/8 "	Marked	
44	No joint	Contact	1/8 "	Medium	
45	No joint	1/4 inch	1/4 "	Marked	
46	Joint	Contact	1/4 "	Medium	
47	Joint	1/8 inch	1/8 "	Marked	
48	No joint	1/4 "	1/4 "	Medium	
49	Joint	? joint	1/4 "	Medium	
50	No joint	Contact	1/4 "	Medium	
51	Large joint	1/4 inch	1/4 "	Marked	
52	No joint	1/4 "	Contact	Marked	
53	?	Contact	1/4 inch	Marked	
54	Joint	1/4 inch	1/4 "	Marked	
55	Large joint	1/4 "	1/4 "	Medium	
56	Small joint	? joint	1/4 "	Medium	
57	No joint	1/4 inch	1/4 "	Medium	
58	Joint	Contact	3/8 "	Slight	
59	No joint	Contact	3/8 "	Medium	

No.	Scaphoid and cuboid.	Scaphoid and os calcis.	Astragalus and cuboid.	Curve of calcaneo cuboid joint.	Remarks.
60	Joint	1/4 inch	1/4 inch	Medium	
61	No joint	1/4 "	1/4 "	Medium	
62	Large joint	Contact	3/8 "	Slight	
63	No joint	1/4 inch	3/8 "	Marked	
64	No joint	Contact	1/4 "	Slight	
65	Joint	3/4 inch	Joint	Very marked	Large cub. secund. adherent to cuboid.
66	Large joint	Joint	3/8 inch	Marked	
67	Small joint	Contact	3/8 "	Flat	Flat foot.
68	Small joint	Joint	1/4 "	Medium	
69	Joint	1/4 inch	1/4 "	Medium	
70	No joint	Contact	1/4 "	Slight	
71	Large joint	1/8 inch	1/8 "	Marked	
72	Large joint	1/8 "	1/8 "	Very slight	
73	No joint	3/8 "	Contact	Medium	
74	Large joint	Contact	1/4 inch	Marked	
75	No joint	Joint	3/8 "	Marked	
76	Joint	1/4 inch	1/4 "	Medium	
77	No joint	1/4 "	1/4 "	Slight	
78	Joint	Contact	3/8 "	Medium	Evidences of rheumatoid arthritis.
79	Small joint	1/4 inch	3/8 "	Marked	
80	No joint	Joint	1/4 "	Very slight	
81	No joint	Contact	1/4 "	Medium	Arthritic foot.
82	Large joint	Contact	3/8 "	Medium	
83	No joint	1/4 inch	1/4 "	Marked	
84	No joint	1/4 "	Contact	No curve	Pronated foot.
85	?	1/4 "	1/4 inch	Very marked	Cub. secund. united to cuboid with a joint on it for scaphoid.
86	Large joint	1/4 "	1/4 "	Slight	
87	Large joint	Contact	1/4 "	Marked	
88	Joint	Contact	1/4 "	Marked	Cub. secund. adherent to scaphoid
89	Joint	Contact	1/4 "	Marked	with joint for cuboid.
90	Joint	1/4 inch	1/4 "	Marked	
91	No joint	1/4 "	1/4 "	Medium	
92	Large joint	1/8 "	1/4 "	Medium	
93	No joint	1/4 "	1/4 "	Slight	
94	No joint	1/8 "	3/8 "	Medium	Osteo-arthritic changes about head
95	Large joint	Contact	1/4 "	Marked	of astragalus.
96	Large joint	1/4 inch	3/8 "	Slight	
97	No joint	1/8 "	1/4 "	Medium	
98	Small joint	1/4 "	1/4 "	Medium	
99	No joint	Contact	3/8 "	Slight	
100	Small joint	1/4 inch	1/4 "	Slight	
101	No joint	1/8 "	3/8 "	Marked	
102	Joint	1/8 "	1/4 "	Marked	
103	No joint	1/8 "	1/4 "	Slight	
104	Joint	Contact	3/8 "	Marked	
105	Small joint	1/8 inch	1/4 "	Marked	
106	Small joint	Contact	3/8 "	Medium	
107	Small joint	1/2 inch	Joint	Very marked	Scaphoid cup oval. Cub. secund. adherent to cuboid with joints for astragalus and scaphoid.
	66 joints	Contacts 29 Joints 9	Contacts 4 Joints 3		

NOTE.—The term "joint" as used in the above table is equivalent to "articular facette."

TABLE II.—OBSERVATIONS ON 70 DISSECTED FEET.

No.	Scaphoid and cuboid.	Scaphoid and os calcis.	Astragalus and cuboid.	Curve of calcaneo cuboid joint.	Remarks.
108	?	1/8 in. apart, ligaments	1/8 inch apart	?	
109	?	1/4 inch, ligaments	1/4 inch	?	
110	?	?	Contact	?	Non-deforming club-foot. Scaphoid cup oval. Cub. secund. united with cuboid.
111	?	1/8 inch, ligaments	1/8 inch	?	
112	?	3/8 inch, ligaments	3/8 inch	?	Scaphoid cup square. Cub. secund. united with scaphoid.
113	?	1/8 inch	1/8 inch	?	
114	1/4 by 1/2 in. joint on anterior superior angle	?	?	Flat	
115	Joint on ant. sup. angle	Contact	?	?	Scaphoid cup square. Probably cub. secund. united with scaphoid.
116	3/8 by 1/2 in. joint, nearly whole surface	?	?	?	
117	No joint, 1/4 in. apart	?	?	?	
118	Small round joint	.....	.....	.....	
119	1/4 in. round joint	.....	.....	.....	
120	Joint	.....	Joint	.....	Very long internal angle on cuboid, probably a fused cub. secund.
121	1/4 in. joint, ant. sup.	Joint	.....	.....	Scaphoid cup square; internal angle of scaphoid in contact with sustentaculum tali, joined by ligaments.
122	1/4 in. joint, ant. sup.	Contact	.....	.....	
123	No joint	1/4 inch, ligaments	.....	.....	Flat foot. Hallux valgus extremis.
124	1/2 in. joint nearly continuous with that for cuneiform	.....	.....	.....	
125	Contact, no joint	....	.....	.....	
126	1/4 in. joint	.....	Joint	Marked	Cub. secund. united to cuboid.
127	No joint	1/8 inch, ligaments	.....	.....	
128	3/4 in. joint	1/4 inch, ligaments	.....	.....	
129	No joint	.....	.....	.....	
130	No joint	Joint	.....	.....	
131	No joint	.....	.....	.....	
132	No joint	1/4 inch, ligaments	1/4 inch	Very marked	Cub. secund. united with cuboid, and very large. Very strong foot.
133	Joint	Contact	Separated by 1/4 inch bone	.....	
134	Whole outer surface of scaphoid a joint	.....	Nearly 1/2 inch apart	Straight line	Small foot.
135	No joint	Small joint	.....	.....	Strong foot.

No.	Scaphoid and cuboid.	Scaphoid and os calcis.	Astragalus and cuboid.	Curve of calcaneo cuboid joint.	Remarks.
136	No joint	.....	1/4 inch	Flat	Large foot.
137	1/2 by 3/8 in. joint	1/4 inch, ligaments	.....	Very flat	Scaphoid cup square.
138	No joint	1/4 inch, ligaments	.....	Slight	Strong foot.
139	No joint	1/8 inch, ligaments	.....	Medium	Weak foot.
140	Joint small and low down	1/8 inch, ligaments	.....	Marked	Cub. secund. united with cuboid, and carrying joint for scaphoid. Hallux valgus.
141	No joint	1/4 inch, ligaments	.....	Medium	Small, good foot.
142	No joint	3/8 inch, ligament	.....	Medium	Good foot.
143	No joint	1/4 inch, ligaments	.....	Marked	Strong foot.
144	Joint 3/8 in. square	1/16 inch, ligaments	.....	Medium	Large foot, fair arch.
145	No joint	3/8 inch, strong ligaments	.....	Very slight	Extreme hallux valgus.
146	No joint	1/16 inch, ligaments	.....	Very slight	Long, strong foot.
147	No joint	1/8 inch, ligaments	.....	Very marked	Long foot, weak arch, pronates easily.
148	Large joint	1/16 inch, ligaments	.....	Very slight	Good foot.
149	No joint	3/8 inch, ligaments	.....	Very slight	Long foot, fair arch, inversion of sole easy, no eversion possible.
150	No joint	3/8 inch, ligaments	.....	Very slight	Hallux valgus.
151	Joint on ant. sup. portion	1/8 inch, ligaments	1/4 inch	Marked	Scaphoid cup circular.
152	No joint	1/8 inch, ligaments	1/4 inch	Medium	Scaphoid cup oval.
153	No joint	1/4 inch, ligaments	1/4 inch	Medium	Scaphoid cup slightly square.
154	Joint 1/4 by 3/8 in. high	1/4 inch, ligaments	1/4 inch ligaments	Slight	Scaphoid cup oval.
155	Contact	Joint?	3/8 inch	Medium	Scaphoid cup slightly square.
156	?	3/8 inch, strong ligaments	3/8 inch strong ligaments	Very slight	Scaphoid cup square. Cub. secund. adherent to scaphoid?
157	Very small joint, ant. sup.	1/4 inch, ligaments	3/8 inch	Very marked	Scaphoid cup oval. Cub. secund. united with cuboid?
158	1/4 inch sq. joint, ant. sup.	1/4 inch, ligaments	1/4 inch	Medium	Scaphoid cup square.
159	No joint	1/8 inch, ligaments	3/8 inch	Slight	Scaphoid cup round; large foot.
160	Joint low	1/4 inch, ligaments	1/8 inch	Very slight	Scaphoid cup square. Cub. secund. united with scaphoid, carrying joint for cuboid.
161	Contact	1/16 inch, ligaments	3/8 inch	Medium	Scaphoid cup oval; small rather flat foot. Hallux valgus.
162	Contact	1/2 inch, ligaments	1/4 inch	Medium	Scaphoid cup slightly oval; foot slightly flat, pronated.
163	1/4 by 3/8 in. joint, ant. sup.	Contact	1/4 inch	Marked	Scaphoid cup oval.
164	Large joint	Bony ankylosis 3/8 inch thick	1/2 inch	Medium	Scaphoid cup square. Cub. secund. united with scaphoid.
165	No joint	1/4 inch, ligaments	3/8 inch	Very slight	Scaphoid cup slightly square.
166	No joint	? joint	1/2 inch	Slight	Scaphoid cup slightly square

No.	Scaphoid and cuboid.	Scaphoid and os calcis.	Astragalus and cuboid.	Curve of calcaneo cuboid joint.	Remarks.
167	⅞ by ½ in. joint	Fibrinous union 1/2 inch wide	.....	Practically flat	Scaphoid cup square.
168	No joint	Contact	3/8 inch	Medium	Scaphoid cup oval.
169	No joint	1/4 inch, ligaments	1/4 inch ligaments	Flat	Scaphoid cup square. Cub. secund. united with scaphoid.
170	1/4 by 3/8 in. joint	Bony ankylosis	3/8 in., no ligaments	Slight	Scaphoid cup quite square; good arch; fair foot.
171	Small joint above, fibrous union below	1/16 inch, ligaments	3/8 inch	Medium	Cuboid and scaphoid united at lower angle. Cub. secund. seemingly having united to both.
172	No joint	1/8 inch, ligaments	1/4 inch	Slight	Scaphoid cup rather square. Cub. secund. united to scaphoid?
173	Small joint, high	1/8 inch, strong ligaments	3/8 inch	Very marked	Scaphoid cup oval. Cub. secund. united with cuboid.
174	No joint	1/8 inch, strong ligaments	1/4 inch	Very slight	Scaphoid cup rather square.
175	No joint	Contact	1/4 inch	Medium	Scaphoid cup oval; small good foot.
176	No oint	1/8 inch ligaments	1/4 inch	Marked	Scaphoid cup slightly square.
177	Small joint, anterior	1/4 inch ligaments	3/8 inch	Marked	Scaphoid cup slightly square.
	29 joints	Contact 8 (3 ankyl.) Joints 5	Contact 1 Joints 2		

An examination of these tables seems to show the following points of interest:

A. *The Articulation between the Scaphoid and Cuboid.*

Of this Quain[1] says: "On the outer end (of the scaphoid) there is, in some instances, a small articular surface for the cuboid bone." This joint was found to be present in 66 cases out of a total of 107 in the bony specimens, and in 29 out of 70 in the dissections, so far as noted, for in many of these it was not recorded. This gives a total of about 53 per cent. Pfitzner found 50.4 per cent. in cases examined by him. In character it was found to vary greatly, most of the cases showing a small circular synovial joint situated high up on the cuboid at the anterior extremity of its internal surface, in a few instances communicating with that of the middle cuneiform. At times this joint surface was so large as to occupy the entire external surface of the scaphoid, leaving practically no

[1] Quain's Anatomy, 10th edition, vol. i., p. 130.

space for the ligaments to bind the end bones together. Again, it was found restricted to a small area at the lower posterior angle of the adjacent surfaces, carried, it would seem, only by the additional segment of bone, to be spoken of later.

B. *The Calcaneo-cuboid Articulation.*

In describing this joint Holden[1] says: "The anterior surface of the os calcis presents a rounded triangular smooth surface, covered by cartilages in the recent state, for articulation with the posterior surface of the cuboid. The upper edge of the surface overhangs the lower, overlapping the corresponding part of the articular surface of the cuboid. When traced vertically the surface is concave from above downward; but when followed from above downward and inward it is sinuously curved, presenting first a concavity, next a convexity, and, lastly, a slight concavity at its lower and inner part . . . mechanically the hanging of the upper edge over the corresponding edge of the cuboid throws the weight of the body, coming down from above, on to the cuboid, and prevents the natural tendency of the forepart of the os calcis to be displaced downward."

This important joint was found to show a great range of variation. At times the cuboid was so much prolonged below at its posterior internal angle as nearly to lock the joint by forming a shelf under the anterior extremity of the calcis; at other times the opposing surfaces were so nearly vertical as to offer no hinderance whatever to a displacement of one bone upon the other.

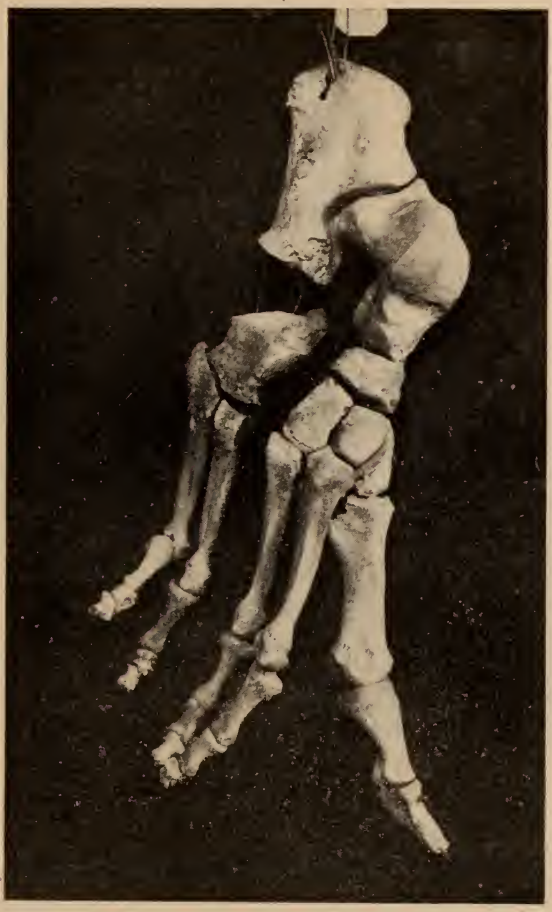
C. *An Astragalo-cuboid Articulation.*

In the typical foot of the anatomies the cuboid is separated from the head of the astragalus by quite a distance, the space being filled by the external calcaneo-navicular ligament. In a certain number of cases, however, the lower internal corner of the cuboid projects so far that it lies against the inner surface of the head of the astragalus, in some instances a true synovial joint being interposed between the two. Nos. 14, 28, 52, 65, 73, 84, 107, 110, 120, 126 showed this variation. Fig. 1, a photograph of No. 28, shows a large articular facette, upon the projecting angle the cuboid. In Fig. 2, No. 107, the

[1] Holden's Human Osteology, 1887, 7th edition, p. 237.

astragalus has been removed to show the surprising distance that the internal angle of the cuboid projects below that bone; its end carries an articular facette that is circular and somewhat over one quarter

FIG. 1.

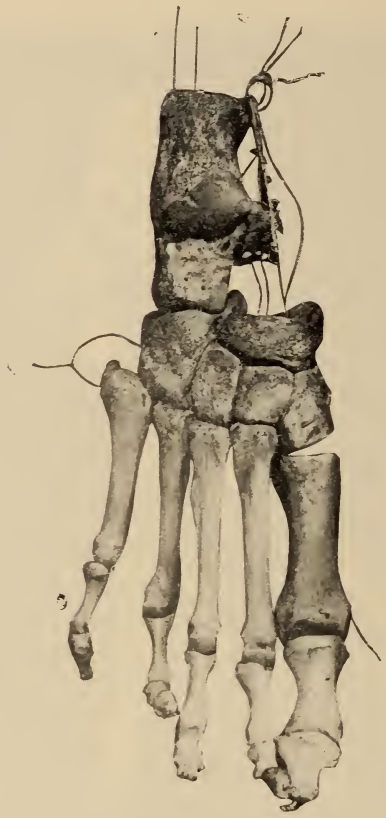


Showing the internal angles of the scaphoid much elongated by the fusion of a cuboides secundarium. No. 28 in the table.

of an inch in diameter. In the recent state this joint must have been situated just in front of and below the external facette on the sustentaculum tali. The inner side of this projection shows a small

articular facette for the scaphoid. The result must have been a bony socket for the head of the astragalus for nearly three-fourths of its circumference.

Fig. 2.



Fusion of cuboides secundarium with cuboid, astragalus removed to show the internal angle of cuboid projecting under the head of astragalus. No. 107.

Fig. 3 is from an admirable X-ray of No. 2, that was kindly taken for me by Dr. Wiegel. It shows a cuboid with a very long internal angle, but on which no evidence could be found of an articular facette.

In the series of bone preparations a contact was found between the cuboid and astragalus in four cases, and evidence of a true joint in three; in the fresh specimens there was one contact and two well-

marked joints. Although the resulting percentage is only a little over $5\frac{1}{2}$ (5.64) per cent., yet I feel sure that this condition was present in some of the cases that had to be questioned in the table, which would have raised it somewhat. The effects of such a con-

FIG. 3.

X-ray of foot No. 2, showing the internal structure of a cuboid with much elongated internal angle.

dition as this upon the mechanics of the foot must be considerable, as any depression of the head of the astragalus would tend directly to raise the outer border of the foot by tilting the cuboid.

D. *A Calcaneo-scaphoid Articulation.*

This condition, which is exactly the reverse of the one just considered, seems to be of much more frequent occurrence. In most

feet the antero-internal angle of the os calcis is separated from the outer edge of the scaphoid by about one-eighth to one-quarter of an inch of ligament which binds them firmly together. These two bones were found in contact in thirty of the osseous specimens, and evidences of an articular facette in nine. In the dissections five synovial joints were found in this situation; in five the bones were in contact, but presented no true joint; in one a fibrous ankylosis was found, and in two a bridge of osseous tissue connected the two bones that were fully three-eighths of an inch thick (Nos. 164, 167,

Fig. 4.

Showing medio-tarsal joint in which the scaphoid and os calcis are in contact (probably ligamentous union) for over an inch. From collection of Prof. Dwight.

and 170 of the series). This anomaly has been described many times, having usually been discovered in attempting to perform Chopart's amputation, as in the case figured by Cruveilhier,[1] who says: "Nothing previously denoted the existence of the anomaly found by chance in practising Chopart's operation on the cadaver." Leboucq[2] speaks of it as the most common of the ankyloses found in the foot, and points out the fact that in fœtuses of 20–40 mm. in length the scaphoid and calcis are always in contact.

[1] J. Cruveilhier. Anatomie Pathologique des corps humain. 2 livr., Pl. iv., Fig. 5. Paris, 1829–35.

[2] H. Leboucq. De la soudure congénitale de certain os du tarse. Bull. de l'Acad. de Médecine de Bruxelles, 1890.

The above tables show some form of anomaly at this joint in 28 per cent. of the cases, so that its effects upon the movements of the foot will be well worth more careful study. The only observation I can as yet make is that in the three cases of ankylosis I failed to detect it before making the dissection, although it seems scarcely possible that a careful examination with this in view would not have revealed it. Fig. 4, from Prof. Dwight's specimen, shows the line of contact between the calcis and scaphoid, which run in apposition for a truly surprising distance, and must have been quite firmly united in the recent state.

The simplest explanation of the origin of these variations in the shape of the tarsal bones and their several articulations seems to be that they are due to the presence of an extra bone, an "os intertarsale." Unfortunately, no case has yet been reported in which the hypothetical bone has been found entirely free—its fate seeming to be analogous to inconstant elements in the hand, they must become united to some constant element or disappear. There are several regions in the foot where these adventitious bones are apt to be found, and special names have been given them. Any consideration of the "os trigonum," the "tibiale externum," or the "os intermetatarsale" has been omitted, because it is hard to see how any alterations in the mechanism of the foot can be caused by their presence. The first of these, spoken of by Quain as a "separation of the external tubercle at the back of the astragalus," has given rise to considerable discussion as to whether it was not a fracture; the second, or "tibiale externum," becomes united to the tuberosity of the scaphoid, and forms a protuberance on the inner side of the foot; the third lies commonly between the bases of the first and second metatarsal bones.

In the line of the medio-tarsal articulation, Pfitzner thinks that two distinct supernumerary bones are met with: a small one, called the "calcaneus secondarius," which always lies at the upper and inner angle of the calcaneo-cuboid joint, and unites only with the calcaneum, and the large and important "cuboides secundarium," which originates at the plantar aspect of the triangle made by the scaphoid, cuboid, and the greater process of the os calcis. It seems never to unite primarily with the calcis, but coalesces either with the cuboid or the scaphoid. When united with the cuboid it gives rise to the

long internal angle, before described, and reaches in many cases as far as the head of the astragalus. Nos. 2, 28, 65, 85, 110, 120, 126, 132, 140, 173, and Figs. 1, 2, and 3 illustrate this. On the

Fig. 5.

Photograph of plantar surface, showing cuboides secundarium fused to internal angle of scaphoid, articulating with cuboid and os calcis. From collection of Prof. Dwight.

other hand, it may become united with the scaphoid and so prolong the lower external angle of that bone that it comes into contact with the major process of the os calcis. Nos. 12, 88, 107, 111, 115, 137, 156, 160, 164, 169, 170, 172 are cases of this kind. Fig. 5 shows a specimen in which a remarkably distinct and round cuboides secundarium had united in this way with the scaphoid ; its end was in apposition with the os calcis, a synovial joint being interposed. On its inner side was an articular facette for the head of the astragalus, and another smaller one on its outer side for articulation with the

FIG. 6.

Same as Fig. 5. Showing posterior facette of scaphoid altered into a quadrilateral by the fusion of a cuboides secundarium. From collection of Prof. Dwight.

cuboid. The same specimen is shown in Fig. 6, but the scaphoid has been so rotated that its posterior cup-shaped facette is shown, illustrating the change from a round or oval into a square, caused by the fusion of a cuboides secundarium at its lower internal angle.

In specimen No. 171 the cuboides secundarium has apparently united with both scaphoid and cuboid, thus welding the two bones into one at the lower posterior angle. It is the opinion of Pfitzner that all synostosis of constant tarsal elements takes place thus through the medium of such an inconstant one, and he explains the union of

the scaphoid and os calcis, before alluded to, as arising in this way. Leboucq, on the contrary, regards this latter anomaly as due to a failure of the "lacune articulaire" to form between the cartilages as they grow to meet each other.

Another point which the writer feels it to be of great importance to have studied in this connection is the variations in shape met with in the anterior facette on the top of the os calcis. It is found to vary from an oval, through the various forms of the hour-glass, to a condition in which two distinct facettes are found, the relation of whose planes must, it would seem, have an important influence upon the action of the astragalus when supporting the body-weight. Fortunately, this articulation has been most carefully investigated by Prof. Dwight himself, whose observations are now about to be published. My own scanty notes upon the subject are, therefore, not given in these tables.

These observations, that I have tried to record, would seem to show that in 33 per cent. of human feet some form of variation from the type described in our anatomies is to be expected at the medio-tarsal joint. Many of these variations must influence the mechanism of the foot to a considerable extent. They are offered now in the hope that they may stimulate further study of the mechanics of the foot, especially in their bearing upon the treatment of those conditions commonly classed as pes valgus. That such a study will require much time for experimentation before any practical deductions can be offered is the excuse for presenting now what can only be called a preliminary discussion.

AN ANATOMICAL CONSIDERATION OF PRONATION AND ITS RELATION TO TREATMENT.

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The eye detects no difference except in degrees between the appearance of the inner arch of the foot in the physiologically pronated position and in the excessive pronation associated with its characteristic discomfort and pains. If one compares, too, the motions executed by the bones of the tarsus and metatarsus when the position is shifted from one of natural supination to natural pronation, determined by Golobiewski, with "the horizontal rotation of the astragalus, with the sinking of its head, the rotation in valgus of the calcis beneath it, and rotation in valgus and abduction of the front part of the foot as a whole," observed by Drs. Lovett and Cotton to be associated with the excessively and painfully pronated foot, one notes again that the evolutions of the bones differ in degrees but not in character. It is a well-recognized fact clinically that if this condition—too much pronation—lasts a long time without correction, structural changes take place in the bones, the deformity becomes greater, is associated with impairment or loss of ligamentous elasticity, muscle fatigue, the various muscle spasms and pains characteristic of flat foot.

One may conclude, then, that there is always, when standing or walking, a pronating force continuously active, for the inner arch, bearing part of the body-weight, must always be ready to yield downward and inward and to rebound, or locomotion would be without elasticity, the gait graceless; and if the conscious or unconscious muscular opposition to it is not appropriately and proportionately

applied and sufficient to prevent the bones of the inner row from going through their small but nevertheless necessary evolutions in the momentary shifting from supination to pronation, too much strain comes upon the ligaments, and some one of the many degrees of the weak foot, between the slight yielding beyond the physiological as one and the structurally flattened foot as the other limit, must be the result.

Clinically, the relation between the foot pronated, with abduction, with partial preservation of the long arch and the foot truly flattened, with abduction and pronation more or less fixed, is thoroughly recognized. The conditions are called weak foot, pronated foot, flat foot, according to which one of the terms is first thought of. The inward roll and abduction have by one writer been dwelt upon as the chief condition to treat in flat foot, but the recognition of the fact that these different types of one broad condition are due to the inability of the foot, from many predisposing causes, to preserve its integrity when the *pronating force* is too great for its strength, does not seem to have led to the formulation of principles to be borne in mind in shaping a plate to overcome this element in flat foot. With the exception of the Whitman plate, which, not by support beneath, but by the impinging of the scaphoid upon a metal flange, suggests to the patient to be on guard and to voluntarily hold the foot in a position of supination, the method used by nature has not been utilized in the manufacture of the support, the stated principle upon which they are constructed being that the lift should come beneath the head of the astragalus, a lift anterior to this being disregarded unless anterior metatarsalgia is definitely associated with the other pains. Where decided pronation is present the difficulty has been not in lifting up the arch but in preventing the inward roll by the plate.

While no two patients have absolutely the same needs for support, the foot skeletons of all individuals are constructed upon the same general mechanical principles to resist the pronating force, the inward roll, abduction, and flattening being the result when its action is not checked.

The plate is a splint for the bones which should hold the tarsus up in the same way the muscles do to prevent the strain falling upon the ligaments or too much upon groups of muscles. The problem is to preserve the two arches to be mentioned, and to do that, certain

thrusts must be made upon the bones of the inner row at the points and in the manner to be indicated.

Acknowledging the correctness of the observations of Golobiewski on the directions of rotations and yielding of the bones in the natural pronated position, and of the observations of Drs. Lovett and Cotton on the excessively pronated foot, these being alike, but in the latter condition so great that there is strain upon the muscular and ligamentous structures, and applying simple mechanical principles to a consideration of the anatomical shapes of the bones of the inner row and the meaning of their position, one must conclude that so long as the pronating force is not minimized, even if there be a high arch with not much rolling in, there must be an active tendency for the weakened condition to continue.

Attention has been directed to the dynamics of pronation, chiefly from the point of origin of the motion at the hip-joint down to the medio-tarsal joint, at the inner end of which most of the force producing the inward roll is applied by the head of the astragalus. The importance of flexion and adduction of the head of the great metatarsal has long been recognized, the development of strength in the tibiales, flexors, and adductors of the great toe, and, therefore, the head of the great metatarsal has long been a part of routine treatment; but there has been a skip in anatomical consideration from the medio-tarsal joint to the great toe. The above-mentioned muscles, when their tone is normal, prevent the yielding of the tarsus, but if a part or all of them are not doing their work properly, the *anterior half of the tarsus and the great metatarsal* must be held in the proper anatomical relation by the plate to most advantageously assist the weakened muscles. They are all attached to the bones of the inner row *anterior to the head of the astragalus.*

It is true that the Thomas sole shifts the weight to the outer arch, but if the plate within the shoe is not shaped so as to overcome the pronation too much disadvantageous strain must still fall upon the ligaments of segments of the foot, if there is not a good anterior lift to the plate. It is recognized that such is the power of accommodation of the foot that results are obtained without the most perfect adaptation of the plate to the conformation of the volar surface of the foot skeleton, but perhaps some difficulties with the troublesome cases of flat foot with marked pronation, abduction, and valgus rota-

tion of the front part of the foot may be explained by the failure to apply to the shape of the plate the one or two principles herein to be stated.

There remains as a slight addition to the study of the mechanics of flat foot to call attention to the shape of the scaphoid, first cuneiform, tarsal end of the great metatarsal, the part they and their positions play in the arch formations of the inner row of bones, and how flexion chiefly and adduction of the head of the great metatarsal, assisted by the action of the tibiales, thrust the head of the astragalus upward and outward, corrects pronation. The principles are easily applied to the plate.

It is perhaps well in this connection to consider how nature does this.

An example of natural flat foot prevention, one often seen, is that of the knock-kneed child with no twisting of the tibia, walking with the toes turned in. If the child walks barefooted it is seen that the great toe grasps the floor. The strain falling upon the inner arch tires the muscles supporting it, the child intuitively adducts the head of the great metatarsal, strongly flexes the head, lifting the mid-tarsus, heightening the inner long arch. In this way the muscles are able to do their work without too much strain.

A good way to personally appreciate this method is as follows: Assume the position in a chair most natural for easily rising. The legs are flexed at the knees at or beyond a right angle, the knees widely separated, heels approximated, the front part of the foot abducted—a typical pronated position—knees flexed, the tibia rotated in, the astragalus and calcis rotated in valgus. It is easy to rise from this position. If the toes are now turned in without changing the position of the knees and heels some difficulty is experienced on trying to get up from the chair. If in addition to the adduction of the front part of the foot the floor is gripped with the great toe, it is not only difficult to rise, but uncomfortable muscular strain is felt in the legs and thighs. It means that flexion chiefly and adduction of the great toe has changed the angle of the ankle-joint from a pronated position to a supinated position by lifting and outwardly rotating the astragalus, and the muscular difficulty felt on rising is an appreciative estimation of how a flexed and adducted position of the head of the great metatarsal overcomes the pronating force.

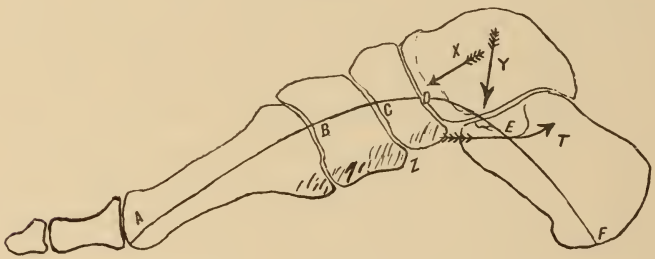
An experiment with a tape gives a suggestion. Hold one end of a lead tape by finger pressure upon the dorsum of the cuboid, pass the other end beneath the foot and out under the inner border of the foot behind the scaphoid—*i. e.*, beneath the head of the astragalus and the sustentaculum tali. Tell the patient to pronate the foot, at the same time pull upward with the inner end of the tape; pronation is hardly at all checked. Move the inner end of the tape so that when you pull upward the scaphoid is lifted; more resistance to pronation is offered than with the first position of the tape. Shift the inner end so that by the pull upward the posterior end of the first cuneiform is lifted; pronation is most decidedly opposed. Move the tape so that the lift comes anterior to this point; pronation is facilitated. In other words, carrying the lift forward as far as the posterior half of the internal cuneiform accomplishes what is done by the tibiales, flexors, and adductors of the great toe. It is not accomplished unless you do carry the lift to that *point anterior to the head of the astragalus.* With every structurally intact foot this is true; with feet beginning to give way it is true; with the most extreme grades of pronation with abduction of the front part of the foot it is not true until, if it be a mobile foot, the position is corrected by the hands, the foot put to the floor, and the tape applied so as to lift the cuneiform. If this is done the lift holds the foot in a position of correction. With spastic feet corrected by manipulation under ether and the application of plaster-of-Paris bandages the same thing applies.

The position of advantage then is flexion chiefly and adduction of the great metatarsal head, lifting the mid-tarsus as far forward as the first cuneiform. If the muscles are unable to do the work for which they are attached to the inner row, to allow pronation, but not too much of it, beneath the cuneiform is the most advantageous point to lift to help them out.

The explanation is an anatomical one best seen by examining the skeleton, but which may be illustrated. Consider the body-weight to be a force acting downward in the direction of the axis of the shaft of the tibia. It is opposed by an equal force acting oppositely upward in the direction of the shaft of the tibia. The same is true in the foot with regard to the direction of the forces along the axis of the shafts of the bones, only for a long bone is substituted a

number of bones placed in apposition end to end. The astragalus, having no muscular attachments, serves merely to split the body-weight force into a number of components. All components for the purpose of this consideration may be neglected but the pronating ones. These may be said to be two in number, are greater when the body-weight is shifted upon the inner arch, smaller when it is shifted to the outer arch. One of these (Fig. 1, *Y*) acts downward, and tilts the calcis in valgus when unopposed. It falls chiefly upon the inner half of the os calcis and sustentaculum tali, and the only direct muscular opposition it has is by the tendons which, passing beneath the sustentaculum tali, use it as a fulcrum. The other opponent, *X*, acts downward, forward, and inward in the direction of the axis of the astragalus from behind forward, and is

Fig. 1.



applied at the inner end of the medio-tarsal joint anterior to the point of support of the astragalus by the calcis beneath. Its tendency is to crush arch *A B C D E F* at *D*, downward, forward, and inward at *D*, to roll the foot inward, to abduct, and at the same time to rotate in valgus *A B C D*, the peroneus longus pulling outward. It must be opposed upward, backward, and outward at *D*. It is seen that flexion of *A B* increases and strengthens the arch. If *A* is not stable the arch flattens and is less able to stand the strain of *Y*. The reason why flexion of the great metatarsal so decidedly overcomes the inward element of the pronating is due to the relative positions of a tuberosity on the tarsal end of the great metatarsal, the tuberosity of the cuneiform, *i. e.*, its whole inferior border, and of the scaphoid, represented by the shaded ones (Figs. 1 and 4). The tuberosity of the great metatarsal faces downward, the tuberous

lower border of the internal cuneiform faces downward at its articulation with the great metatarsal, and then inclines upward and inward; its posterior extremity faces almost directly inward, so that when the great metatarsal is flexed the thrust of its tuberosity is, by the time its effect reaches the scaphoid, directed upward, backward, and outward against the pronating force, the effects of this thrust being to lift the scaphoid not upward, but upward, outward, and backward against the head of the astragalus. By this relation flexion of the great metatarsal accomplishes what without this relation of the tuberosities would necessitate the position $A'\ B'$ to be changed to $A''\ B''$, Fig. 2; flexion of the great toe is thus equivalent to a good deal of adduction.

The fact that the tuberosity of the internal cuneiform is so situated that a lift beneath it opposes the force X in an opposite direction to its action explains why support at this point checks the pronation. A lift anywhere behind this is not applied at the most advantageous point, though it is certain to help overcome the difficulty.

Not only should the internal cuneiform be lifted at its posterior end, but, as seen in the relation of flexion of the great metatarsal to the opposition to X, the tuberosity of the cuneiform must face inward. Flexion of the great metatarsal cannot be as effective in checking the pronating force, for the reason that the necessary relation of the above-mentioned tuberosities for that purpose is lost; if the facet of the tuberosity is allowed to face downward, arch $A'\ B'\ C'\ D'\ E'$ is markedly weakened, and, again, $A'\ B'$ would have to be shifted to $A''\ B''$ to overcome the pronation (Fig. 2). Normally, the anterior tibial helps check the pronation by so lifting the internal cuneiform (tending to rotate it outward) that its tuberosity at the point Z faces inward. It is seen how the tibialis posticus, acting in the direction of the arrows T and T, opposes X by holding the scaphoid tightly against the head of the astragalus. Let the tibialis anticus be weakened, then the tuberosity of the cuneiform has a tendency to rotate in valgus, spasm of the peroneus; pulling in the direction P, Fig. 3, further increases the valgus rotation and abduction. It is seen that it does not take much abduction of $A'\ B'$ to weaken $A'\ B'\ C'\ D'$, for the anterior part of this arch is almost a straight line, the tuberosity accomplishing by their position the effect of much adduction of A'.

DEDUCTIONS. The pronating force is the active agency when associated with favorable conditions to produce the weakened foot as

FIG. 2.

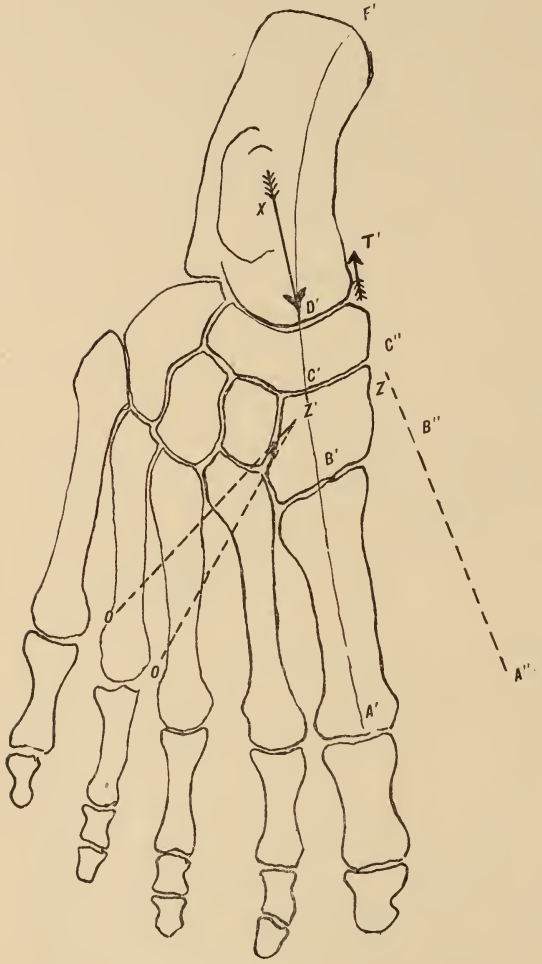
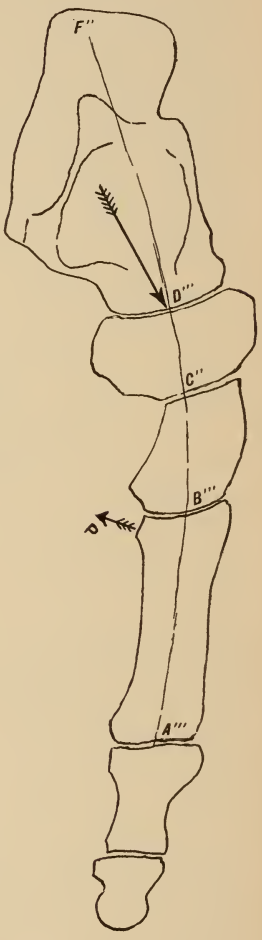


FIG. 3.



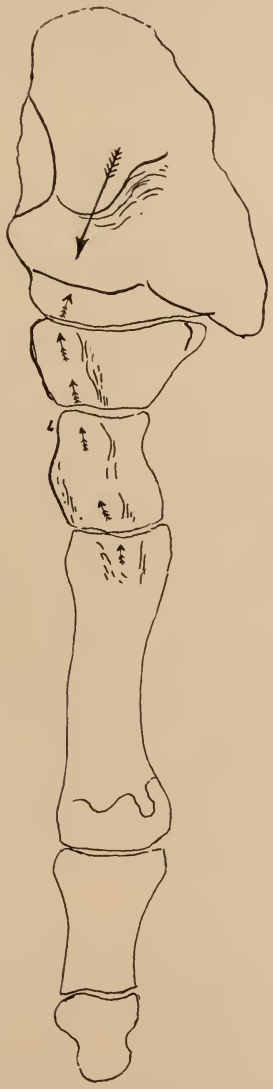
Showing arch, $A'B'C'D'F'$, reversed pronated foot.

has been recognized. Lifting beneath the head of the astragalus does not check the pronation. Lifting beneath the internal cuneiform does, if at the same time the bone is prevented from rotating

in, so that its tuberosity of the internal cuneiform does not fall out of arch A' B' C' D' E'.

The great metatarsal must be allowed to flex.

FIG. 4.



Showing relation of tuberosities; view beneath skeleton.

The lift in the plate should be carried well forward as far as *Z'*, Fig. 2, and then forward and outward along the line *Z' O*, sloping to nothing at *O*, for this copies the conformation of the tarsus, and the lift at *Z'* cannot be borne with comfort without it. Internal to *Z' O* the plate should slope downward, forward, and inward, so that the great metatarsal may drop, the internal cuneiform resting partly upon the summit of the lift, partly upon the inner slope, and is held in a position of outward rotation, Fig. 5.

Fig. 5.

Showing lifting of mid-tarsus and prevention of valgus rotation of first cuneiform.

This sloping downward and inward of the first and second metatarsals, lifting the first cuneiform and the mid-tarsus and the downward and outward sloping of the fourth and fifth metatarsals and cuboid establishes the natural poise of the bones and checks the spasm of the peroneal.

DISCUSSION.

Dr. G. G. Davis, of Philadelphia, said that he had understood Dr. Dane to say that some of these affections were due to some of the supernumerary processes and bones. Personally, he was inclined to think that this might be an effect rather than a cause. These deformities might be secondary results of weaknesses of the foot which allowed increased growth to take place at the points which were relieved from pressure.

Dr. Dane, of Boston, said he had divided his cases into classes, in seventy of which he had made dissections of his own, so that the effect of the cartilages might be given due weight.

Dr. Weigel, of Rochester, N. Y., thought it had been conclusively demonstrated in the foregoing papers and discussion that the

present treatment of painful flat foot is frequently inefficient and disappointing, and that it was necessary to make use of radically different methods from those hitherto in vogue. He urged every member to pay some attention to the special points brought out, so that by collective investigations, made upon the living subject principally, definite conclusions could be arrived at, particularly with reference to the presence of tubercular foci in the epiphysis of the tibia when pain is referred to the heel.

CLUB-FOOT IN THE ADULT.

By B. E. McKENZIE, M.D.,
TORONTO, CANADA.

Though club-foot is seen not very infrequently in persons who have attained to adult years, yet so general is the impression among the laity and in the profession that the condition is incurable that the surgeon's advice is seldom sought. Having had experience, especially in the last two years, with several cases, in persons varying in age between the sixteenth and forty-third years, and believing that the treatment of these cases is eminently feasible, and that the results obtainable are such as to improve in a marked degree the patient's appearance, comfort, and general well-being, I have felt justified in bringing this subject to the notice of the Association.

In all, I have treated seventeen cases between the ages named; seven of these cases were thirty years or older. The average age was twenty-six years. Eleven of the cases had both feet deformed.

I shall give particulars of only a few cases :

Case I.—T. S. D., aged twenty-nine years, tinsmith, had strongly marked deformity of both feet at birth. He is a healthy, stout man of about 150 pounds. No systematic attempt had been made to correct the deformity, which is now typical (Figs. 1 and 2).

First operation with anæsthesia, December 8, 1898, the plantar fascia, tibialis posticus, tendon, and the anterior portion of the internal lateral ligament cut subcutaneously, the anterior portion of the foot strongly abducted and retained in position by plaster-of-Paris casing.

January 10, 1899. Further cutting of restricting bands of fascia subcutaneously, further abduction of the feet and retention by plaster-of-Paris.

February 1*st.* The varus having been overcome, the tendo Achillis was cut subcutaneously and the feet brought to an angle of 100° and retained as before.

FIG. 1.

CASE I.

17*th.* Further correction made by subcutaneous cutting and manual force.

March 10*th.* Dismissed from hospital wearing boots and using crutches. Dorsiflexion to 80°.

FIG. 2.

CASE I.

April, 1900. Patient walks remarkably well, remains upon his feet at business in the store all day, has, in pursuance of his occupation, the putting up of eave-troughs, climbed ladders, and moved

about upon the roofs of buildings. The range of motion at the astragalo-crural joint is about 25°.

CASE II.—F. B., aged sixteen years, double club-foot, congenital and strongly marked, fasciotomy and tenotomy much as in the former case.

August 6th. Further correction made.

FIG. 3.

CASE II.

September 1st. Further correction made.

October 6th. Tendo Achillis cut, and both feet brought to an angle of 90° dorsiflexion. One dressing subsequently, without anæsthesia, brought the feet to 80° of dorsiflexion.

November 19th. Began walking, using boots and a cane. This latter thrown aside in two weeks.

April, 1900. At the present time walks well and suffers no inconvenience through remaining on his feet, as much as demanded by his ordinary work as an office hand. (Figs. 3 and 4.)

FIG. 4.

CASE II.

CASE III.—O. S., aged eighteen years, a large, healthy man of 180 pounds, right club-foot, congenital. Subcutaneous replacement and retention as in other cases.

December 21*st*. Further cutting and replacement.

January 25, 1900. Tendo Achillis cut and equinus corrected.

February 13*th*. Further correction of equinus by manual replacement.

March 4*th*. Dismissed from hospital, walking with a cane.

December, 1899. This patient walks remarkably well, with scarcely a perceptible limp.

CASE IV.—F. S., aged sixteen years, right club-foot, congenital.

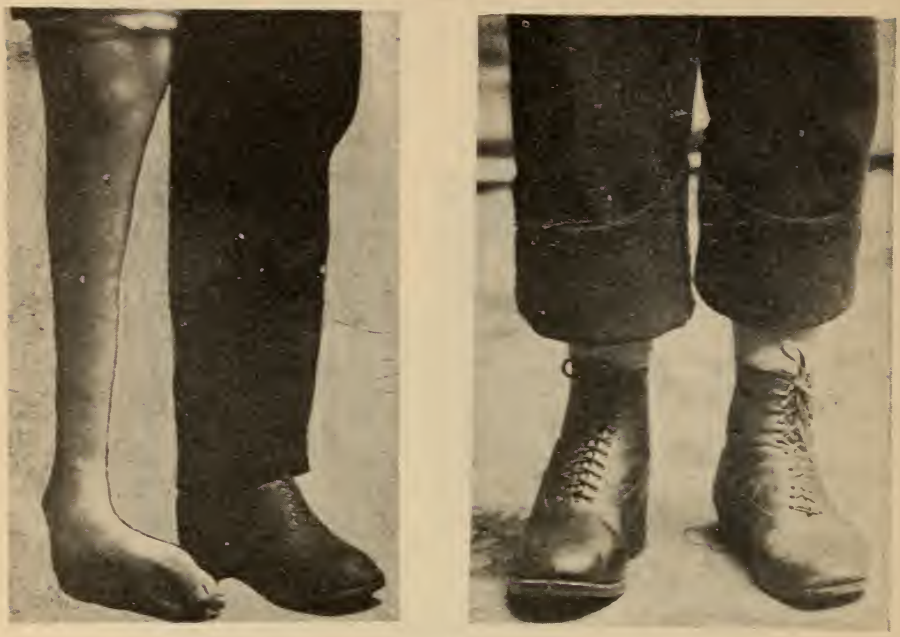
June 6, 1899. By subcutaneous fasciotomy and tenotomy and manual replacement the varus was fully overcome.

20*th*. Tendo Achillis was cut, and dorsiflexion to an angle of 80° secured.

July 13*th*. Dismissed cured.

April, 1900. The foot is unduly pronated, and I have found it necessary to have his foot built as for a moderate case of flat foot.

FIG. 5.



CASE III.

CASE V.—J. C., aged twenty-seven years, right club-foot, congenital.

FIG. 6.

CASE V.

August 23, 1899. Subcutaneous fasciotomy and tenotomy. Partial replacement of the varus and retention by plaster-of-Paris.

September 19*th.* Repeated.

October 10*th.* Repeated.

31*st.* Tendo Achillis cut and equinus so far corrected as to bring the foot to an angle of 90° with the leg.

November 28*th.* Dorsiflexion to 80° secured.

December 2*d.* Dismissed from the hospital.

April, 1900. This patient walks with a very slight noticeable limp. There is good movement in the foot through an angle of 30°. Extreme flexion is shown in Fig. 6.

Case VI.—E. R. F., aged thirty years, double club-foot, congenital. Considerable difficulty was met with in correcting the varus. Anæsthesia given four times at intervals of about four weeks, and feet strongly abducted by manual force. The skin at the inner border of foot having torn through, the opportunity was taken to cut obstructing bands of fascia. In this manner three months were occupied in fully correcting the varus—a much longer time than in any other case. A few days ago the Tendo Achillis was cut, and the feet brought to an angle of 100° with the leg. Still under treatment.

There are a few points in connection with the history of these cases to which I wish to call your attention.

1. They are cases from the sixteenth to the forty-third year of age.

2. In none was there any operative intervention other than subcutaneous cutting. It is true that in three feet—one in Case I., and in both feet in Case VI.—the skin gave way, making an open wound.

3. The average time from the first operation until the patient was able to walk with a cane was about three months.

4. In Case I., T. S. D., in whose foot an open wound resulted through the employment of manual force, the result is less satisfactory than in the other foot. There is a more marked disposition to contraction and less mobility. The same difference is shown in Fig. 7, another patient upon whom I operated in 1890, making the regular open incision recommended by Phelps, in one foot (the right), and employing subcutaneous tenotomy and manual force with more frequent dressings in the other (the left). The

foot in which the open incision was made is not as good as its fellow.

5. Based upon my experience of about 400 cases of club-foot, of which twenty-eight feet were in persons over fifteen years of age, I would say that neither operation on bone, nor the open incision is called for, except in a very small proportion of cases; in less, say, than 5 per cent.

6. The result, other things being equal, is better where there has been no cutting other than that done subcutaneously.

7. The time occupied in treatment is no longer than when the open incision is made.

FIG. 7.

8. Whatever method of treatment be adopted, the deformity of the foot, *per se*, should be fully corrected before the relationship of the foot to the leg be interfered with.

9. In all of the twenty-eight feet here referred to the result is most gratifying, with two exceptions. One of these is a woman, twenty years of age, who weighs about 200 pounds. The deformity in her case was doubtless due to anterior poliomyelitis which came on at a very early age. In this case the foot became displaced too far outward, and her present condition is little better than her former one. A similar result in a slight degree followed in a young man of seventeen, although the case was doubtless congenital.

10. The age of some of these patients, several of them ranging between thirty and forty-three years, and the eminently satisfactory results obtained at this age render it comparatively certain that age is not a serious barrier in the way of correcting this deformity.

TENDON TRANSPLANTATION IN THE TREATMENT OF DEFORMITIES OF THE HAND.

By WISNER R. TOWNSEND, M.D.,
NEW YORK.

Although the operation of tendon transplantation was first proposed by Nicoladoni in 1881, when he successfully attached both peronei to the tendo Achillis in a case of paralytic talipes calcaneus, it is only during the past five years that it has attracted much attention and become one of the recognized methods of treating paralytic deformities.

Many surgeons have reported their results in operations on the feet, but few cases are to be found in which the tendons have been transplanted for the relief of deformities of the hand. The relative infrequency of poliomyelitis of the upper extremities partly accounts for this discrepancy, but there are many patients suffering from drop-wrist, from distortion of the fingers and hand due to cerebral palsies of childhood or to poliomyelitis or cerebro-spinal meningitis, whose deformities could be entirely done away with and who could have more or less complete restoration of function if this operation were performed. Other conditions suitable for the procedure are contractures following cerebral lesions later in life, injuries to the nerves and subsequent paralysis of the muscles, deformities due to muscular action or instances of severed muscles in which their power is lost and the cut ends cannot be found or cannot be reunited.

The term "tendon transplantation" is the one used by most authors, but others prefer to designate the operation as tendon grafting, tendon anastomosis, tendon suture, or function transference. In a review of the literature the following cases have been found:

Case I.—Bernhard.[1] Male, thirty-five years of age. Fell through a glass skylight and received a severe cut of the hand. Made a good recovery, except that stiffness and inability to flex the index finger remained. To relieve this an incision was made over this finger. The peripheral end of the sublimis could not be found. The flexor profundus was found cut close to the bone at the base of the first phalanx, its stump contracted within its fibrous canal; the central end could not be found. By splitting this fibrous canal the peripheral stump was freed and the profundus tendon was drawn out with an artery clamp and fastened to the extensor indicis, which was brought forward by making a tunnel at the metacarpal joint close to the bone. The tendons were united by making a slit in the profundus stump, drawing the extensor through it, and then suturing both tendons together with silk. The external wound was closed and the finger put in flexion. Both wounds healed *per primam.* Dressings were removed on the tenth day, and attempted movement of the finger reopened the skin. This, Bernhard thinks, was due to preoperative trophic disturbances of the skin. The tendons, firmly united, could be seen through the skin opening. Operation proved successful in spite of this reopening, although the exact condition is not given.

Case II.—Franke.[2] Complete cerebral radial paralysis of the right hand, which was held in flexion and absolutely without function. Incision made on ulnar side of forearm. After the flexor carpi ulnaris had been divided its central end was brought around and fastened to the peripheral end of the extensor carpi ulnaris, which had also been cut across. The wound was closed and the hand fixed in hyperextension. Suture material used was catgut. On account of its early absorption the skin reopened; the tendons, however, remained perfectly united. To close the skin opening, silk sutures were used. Wound healed *per primam.* Operation was unsuccessful, in that there was only a minimum amount of extension afterward and the deformity soon returned.

In a second operation on the same individual, Franke decided upon transplanting the supinator brevis, because there was a slight amount of supination present. On examination it was found so atrophied that the plan was abandoned. Instead, the tendon of the

extensor carpi radialis longior was shortened; but, the surgeon not being satisfied, a third operation was done in order still further to shorten the tendon. This was followed by a complete motor paralysis of the forearm, due to the fact that the Esmarch bandage was left on for several hours after the operation, but finally the arm was not only completely restored to its former position but showed marked improvement of the radial paralysis. The hand was somewhat over-extended and the motion was very good.

Case III.—Franke. Motor paralysis of the shoulder, arm, forearm, and hand. An operation was done to improve the radial paralysis. The extensor carpi ulnaris was divided and the central ends sutured to the common extensor of the fingers at the point where it subdivides. Result fairly good.

Case IV.—Keiler.[3] Male, eighteen years of age. Old hemiplegia, paralysis of the extensors of the hand. Function of the thumb and little fingers retained. Tendon of the extensor carpi radialis was sutured to the tendon of the extensor communis digitorum. Result fair.

Case V.—Kirsch.[4] Traumatic cut of the extensor brevis pollicis; the peripheral stump was united to the extensor carpi radialis longior. Result, recovery of the extension of the thumb. This operation was done with infiltration anæsthesia.

Case VI.—Rochet.[5] Female, aged nine years. Deformity following poliomyelitis; paralysis of the abductors of the wrist and thumb. Operation consisted of an incision over the ulnar border of the forearm about eight centimetres in length, extending down to the wrist. The flexor carpi ulnaris was divided near the pisiform bone and the extensor carpi radialis near its insertion. By dissecting back on the dorsal surface the extensor brevis pollicis and the abductor pollicis were freed, and after their sheaths had been opened the central stump of the extensor carpi ulnaris was fastened to them. The hand was placed in radial abduction. A successful restoration of function resulted.

Case VII.—Rochet. Boy, aged fourteen years. Infantile paralysis of right arm and hand. The fingers were held firmly flexed; no extension possible, except in the ring finger and thumb. No adduction or abduction of the thumb, but the latter was held against the second metacarpal bone. A median incision was made on the back of the hand from the wrist to the middle of the forearm. Muscles were cut and an endeavor made to utilize the extensor power of the ring finger and thumb for the other fingers by suturing the following tendons by their lateral borders: (1) The tendon of the extensor brevis and abductor pollicis; (2) the extensor longus pollicis and the extensor indicis; (3) the tendons of the middle and little fingers to the tendons of the ring finger, thus endeavoring to make all the dorsal tendons act in groups of two or three. Three and one-half months after operation the little and index fingers could be voluntarily extended. The middle finger was unimproved; there was slight abduction of the thumb.

Case VIII.—Rochet. Male, aged fourteen years. Right plastic hemiplegia. Hand and fingers held flexed to an acute angle. Median incision on dorsal surface of the forearm above the wrist twelve centimetres long. The extensors of the fingers and the extensors of the wrist were divided six to seven centimetres above the joint. A median palmar incision was then made, and, after dividing the superficial flexors, an opening was made in the interosseous space, and the central stumps of the flexors were brought through and sutured to the peripheral stumps of the flexors. Five months after operation the hand was in line with the forearm; there was extension of the fingers, with the exception of the thumb, which was only restored within moderate limits.

Case IX.—Rochet. Patient aged thirteen years; sex not given. Paralysis of the extensors and of the abductors of the right thumb. An anastomosis was made between the peripheral end of the long extensor tendon and the extensor of the index finger, which was cut just above the upper edge of the "anatomical snuff-box." Result good. Patient could write and make movements impossible before, and when extension of the thumb was made extension of the index finger occurred at the same time, or *vice versa*.

Case X.—Müller.[6] Male; had lost the use of the forearm as the result of a fracture of the humerus, in which an unsuccessful operation had been done to free the callus, after which tendon suture was resorted to. Prior to examination electrical examination showed reaction of degeneration, but the direct irritability of the extensors was not entirely lost. Two and one-quarter years later electric irritability of the muscles of the forearm supplied by the radial nerve was lost completely.

An incision six centimetres long was made on the ulnar side of the forearm above the wrist, the flexor carpi ulnar is exposed and cut close to its insertion and brought above the styloid process of the ulna to the dorsal side. All of the extensors of the fingers and the extensor carpi ulnaris were then cut and united with catgut to the flexor carpi ulnaris, the hand held in extension. Healing was delayed owing to some of the catgut ligatures. At the end of three months improvement was very slight; but, despite the fact that no further treatment was given, the function of the hand steadily improved until seven months after the operation the thumb could be extended, but not abducted, and motions of extensions of the hand were possible. Three months later the strength of the hand had increased and the thumb and index fingers could be voluntarily extended separately and in connection with the other fingers. The one difficulty was that in extending the hand was pulled to the ulnar side. To improve this and also replace the abductor pollicis the following operation was done:

The flexor carpi radialis was freed, but not cut; its lateral edges were freshened and united to the tendons of the abductor pollicis and the extensor carpi radialis longior. The hand was held extended and turned toward the radial side. Improvement was noticed within six weeks after the operation. The thumb could be abducted by the action of the flexor carpi radialis longior, which turned the hand toward the radial side, a condition which was afterward entirely overcome. Several months after the operation the patient could extend the fingers and was able to use the hand for various purposes.

Cases XI. and XII.—Tubby.[7] An incision three inches in length is made in the middle of the forearms as for ligature of the radial artery. The inner edge of the supinator longus is

rapidly defined, and beneath it the radial artery and nerve. The latter structures are drawn inward, and the distal part of the pronator radii teres is separated from the surrounding muscles and fascia. Its tendon is then removed from the radial attachment, care being taken not to remove the periosteum. The pronator radii teres is then held aside and an opening is made into the inner osseous membrane just internal to the inner border of the flexor longus pollicis. An aneurism needle is then passed behind the radius from without inward and as close to the bone as possible. A sufficient space is made for the passage of the tendon of the pronator radii teres, and the aneurism needle is left with its eye toward the ulna. The tendon of the pronator radii teres is then transfixed with silk of medium thickness in the form of a Staffordshire knot, leaving two free ends. The ends are passed through the eye of the aneurism needle, and by traction on it the tendon of the pronator radii teres is brought around the radius. The ends are now utilized in the following way, so as to secure the tendon to the bone. They are rethreaded on separate suture needles, and the tendon is grafted thus to the periosteum. One suture is passed through the periosteum on the outer side of the radius above the transplanted tendon, and the other passes through below. The two ends are then knotted together over the tendon. But I am disposed to think that it is better to work a drill through the bone from before backward and near the outer surface and then secure the ends through the aperture. This completes the first part of the operation.

The second part consists in dividing the tendons at the wrist. A transverse incision is made there, the median nerve is defined and protected, and the following tendons are divided: The flexor carpi radialis, the flexor sublimis, palmaris longus, flexor carpi ulnaris, and, if the thumb is strongly flexed and adducted, the flexor longus pollicis. Both wounds are then closed and dressed and the limb is put up with the elbow extended, the forearm supinated, and with wrist well flexed for eight days. From this time onward till the sixth week the angle of flexion at the wrist is gradually diminished until it is in a straight position. Here the limb should be maintained while the extensors and supinators are massaged and stimulated with interrupted current, care being taken to control the limb

with a splint reaching from the upper arm to the fingers. The arm recovers its use very rapidly indeed.

I have now practised this operation in two cases with great success, and I find that in three months after the operation the patients could use the hands well and perform such fine movements as picking up a pin. If there is any hesitation on a child's part in using the limb, it is well to tie up the sound arm and insist that he use the limb recently operated on.

I desire to place on record three cases that I have personally operated on, and, through the courtesy of Drs. Whitman and Gibney, to add two others.

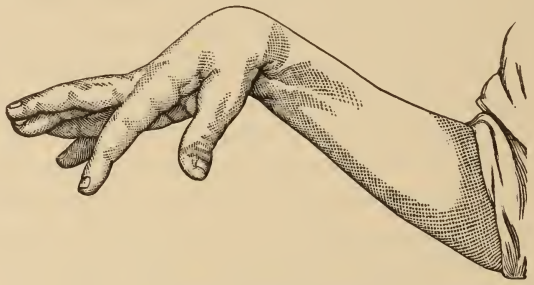
Case XIII.—Male, aged seven years; admitted to the Hospital for Ruptured and Crippled, December 15, 1899, suffering from right hemiplegia, pes equinus, and drop-wrist. When sixteen months old had cerebro-spinal meningitis, followed by paralysis of the entire right side, including face muscles, and also was unable to speak. He has had convulsions since then almost daily (*petit mal*). Before the meningitis the boy was bright, but now shows marked signs of mental deficiency. The foot is held in marked equinus, with slight varus. The right arm is one and one-half inches shorter than the left. There is slight power in the extensor communis digitorum. The wrist is held nearly at a right angle with the forearm, and the flexor muscles of the wrist act; the flexion at the elbow is fair, although extension is limited to 130 degrees. The deltoid is atrophied and there is slight atrophy of the supra- and infraspinatus.

December 12th operation on the foot by Dr. Whitman, and the deformity perfectly corrected; plaster-of-Paris dressing applied. January 9th operation on the wrist by Dr. Townsend; incision two inches long was made over the dorsal aspect of the wrist just above the annular ligament. The extensor communis digitorus tendon was shortened as much as possible by overlapping, and fastened with silk sutures; superficial wound closed with catgut. February 10th dressing removed. Union *per primam*. The hand held in good position. The tendency to drop-wrist has been overcome, but the voluntary power has not been appreciably restored. Part of this may be due to the fact that the boy cerebrates so slowly that it is

impossible to get him to do anything. A brace is applied to hold the hand strongly extended. April 25, 1900, condition unchanged.

Case XIV.—Male, fourteen years of age. Referred by Dr. Sachs. Right hemiplegia, due to cerebral palsy of infancy. Instruments were used at the time of birth, but no damage apparently was done to the exterior of the skull. The patient has had treatment by electricity and massage, and some years ago had his heel cord cut. Has never been able to use the right hand, and it is held in a typical position of claw-hand, it being sharply flexed at the wrist and the fingers flexed on the palm of the hand; the back of the hand is held nearly at a right angle to the forearm. By a vol-

Fig. 1.



Case XIV.—Maximum extension before operation.

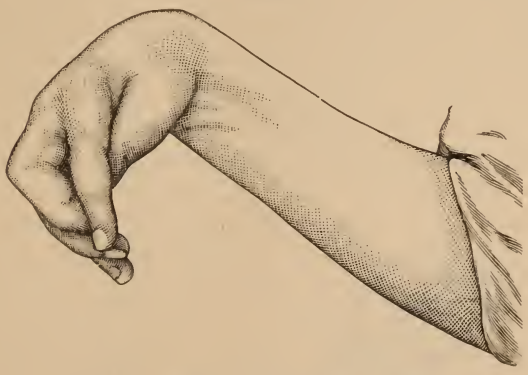
untary movement he can extend the fingers slightly, but cannot extend the wrist.

Electrical examination of the right arm December 20th by Dr. Schlapp: Supinator longus; reaction slight, not enough to overcome the contraction of the pronators. Extensor carpi radialis longior et brevior, extensor carpi ulnaris and extensor of the thumb; no reaction. Extensor communis digitorum; no reaction to the electrical current; seems to react very slightly to impulse of the will. Flexors do not act as well as normal muscles, perhaps due to contracted condition. Flexor carpi radialis and flexor carpi ulnaris react. Flexor sublimis digitorum reacts, but not completely. The anterior pair of its four tendons seem to react slightly. The posterior pair very slightly. Flexor profundus digitorum does not

give a very perfect reaction. The extensor muscles do not react when the nerve is excited. The flexor muscles do as a group.

It is difficult to get reaction of separate or single muscles, because a strong current is necessary to get any reaction, and then

FIG. 2.

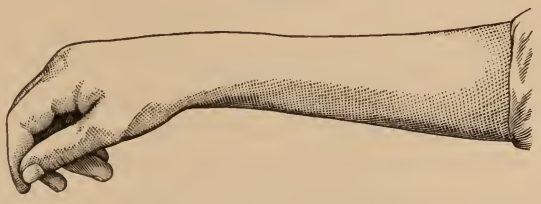


CASE XIV.—Maximum flexion before operation.

the reaction of individual muscles is marked. The circumference of the right hand is one inch less than that of the left.

December 21*st.* At the Polyclinic Hospital, under ether anæsthesia, Esmarch bandage at elbow, the forearm and wrist having been cleansed thoroughly with green soap and bichloride dressing, all hair having been removed by shaving, an incision was made in

FIG. 3.

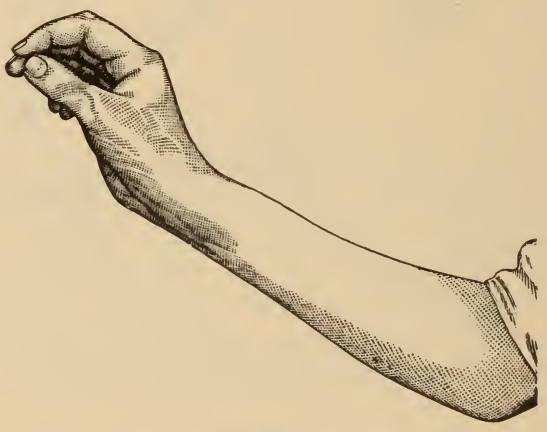


CASE XIV.—Flexion after operation.

the middle of the flexor surface over the wrist, exposing the tendons. The flexor carpi radialis, the flexor carpi ulnaris, and the palmaris longus were divided by scissors just above the annular ligament. Silk was stitched to each tendon and each fastened to an artery clamp, so that they should not draw up out of reach. The

parts were then covered with sterile gauze and the hand turned over and an incision made on the dorsum of the wrist; the extensor communis digitorum was exposed about one and one-half inches above the joint, the tendon being pulled to one side; dissection was made through the upper edge of the pronator quadratus and between the bones to connect with the flexors previously cut. These tendons were then slipped through, and to the extensor communis was attached the three flexor tendons previously mentioned. The lengthened extensor communis digitorum was folded on itself twice so as to shorten it, and between these folds the flexor tendons were stitched. The sewing was done with catgut. The wounds were

FIG. 4.



CASE XIV.—Extension after operation.

then closed with catgut and dry dressings applied. The hand was placed in a hyperextended position and a plaster-of-Paris bandage applied. The wounds healed *per primam*, with the exception of one little spot on the flexor side, where a suture pulled out, which granulated over and closed inside of ten days. All dressings were removed at the end of that time, the arm bandaged and placed in a splint, with a pad of gauze under the hand to keep it and the fingers in extension.

The splint, etc., were removed at the end of six weeks, and the patient has simply carried his hand in a sling since then. The reason for so long delaying the removal of the dressings was to in-

sure, as far as possible, perfect union of the sutured tendons. The hand is held perfectly straight in line with the forearm. The patient has power to extend and flex. He has fair grasp of the fingers; had none before, owing to the position in which the hand was held. When the electrical current is applied to the flexor carpi radialis it is seen that a contraction occurs under the scar, on the dorsal surface of the forearm. In addition the electrical current applied to the extensors gives better reaction than it did before the operation, owing to better position of the hand. Flexion and extension can be carried through an arc of about twenty degrees, and I expect this to be much increased by use, massage, and electricity. April 29th condition of the hand much improved; is able to hold a pen and write his name in a legible way; can pick up objects with his fingers. Flexion of the fingers is increasing, and extension of the hand can be carried further than at the last examination. The hand is held in perfect position, and there is marked increase in strength and better circulation; can flex fingers without thumb getting in the way, as it formerly did. Fig. 1 shows the greatest amount of flexion before operation; Fig. 2 the greatest amount of extension; Fig. 3 the greatest amount of flexion after operation; Fig. 4 the greatest amount of extension after operation.

Case XV.—Male, aged fourteen years, referred by Dr. Leszynsky. Admitted to Polyclinic Hospital, April 5, 1900. Right hemiplegia due to infantile cerebral palsy. The patient had a marked drop-wrist, the latter being held at an angle of about ninety degrees to the forearm, and the fingers flexed, contracted, and firmly held in the palm of the hand. Electrical examination made by Dr. Schlapp. No contraction of the extensor muscles of the forearm, either to faradism or galvanism, even when irritation was applied to the musculo-spiral nerve. The triceps contraction was perfect. The flexor carpi ulnaris and the flexor communis digitorum both reacted perfectly to faradism; the flexor carpi radialis reacted, but in an imperfect degree. Position of the hand is shown in Fig. 5. The boy had no power to flex or extend the hand; slight power of flexion in the fingers.

April 5th, under ether anæsthesia, the forearm having been thoroughly scrubbed and cleansed with soap poultice over night and

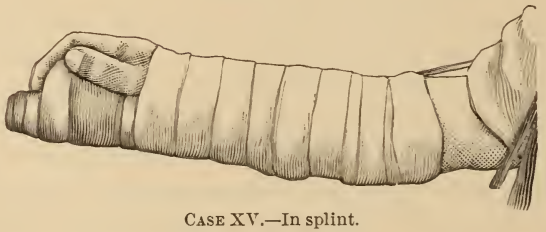
washed with bichloride before operation, an incision was made three inches long on the radial side of the forearm, on the edge of the arm midway between the dorsal and palmar surfaces. The lower portion of the incision reached to the wrist; the skin was dissected backward, and the flexor carpi radialis and the palmaris longus were

FIG. 5.

CASE XV.—Position of hand before operation.

divided as close to the annular ligament as possible, and then dissected upward for a distance of about three inches. Dissection having been carried in the opposite direction to the back of the forearm, an attempt was made to fasten these tendons to the extensor communis digitorum. Just as they were being sewed in the slit of

FIG. 6.

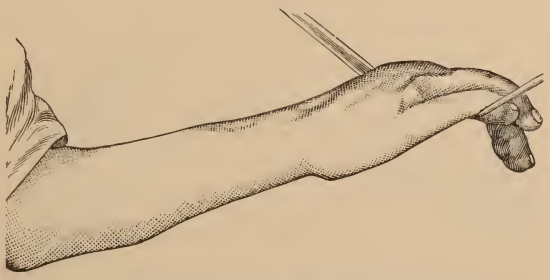


CASE XV.—In splint.

the atrophied tendon the latter tore through in such a manner that it was not possible to attach them. Therefore, the deep extensor was drawn upward, a slip made through it, both tendons drawn through, and then, at a point one-quarter of an inch above, drawn through again, having previously been scarified.

The wrist at the time was held in a position of extreme extension, and the tendons were pulled down and fastened to the extensor tendon as near to the wrist as possible. The tendons were fastened with kangaroo tendon and the skin wound sewed with catgut in a continuous suture. The operation was much delayed by oozing, as the Esmarch bandage was not used. Sterilized dressings of dry gauze were applied, and the arm put up in a hyperextended position and held there by plaster-of-Paris. The highest temperature was reached the day after the operation, when it rose to 100° F., never going above 99° F. after that. The patient did not suffer pain, but there was marked swelling of the fingers for the first few days, although the color was always good and they were never cold. Dressings were removed April 21st. Wound healed *per primam*,

FIG. 7.



CASE XV.—After operation. Weight partly supported.

except for two small spots about the middle of the incision, in which the skin at the edge of the incision was dry, but black and necrosed, evidently due to pressure of the artery forceps, which were used to grasp the skin in one instance where we desired to retract. Dressing of balsam of Peru applied and the arm placed on a board-splint, with a roller bandage under the hand to keep up the hyperextension, and the patient allowed to carry the arm in a sling. April 26th the patient still has very slight swelling of the fingers and wrist. Color, temperature, and sensation normal. The dressings removed again to-day, the two necrosed spots still present, and have not yet separated from the tissue beneath. They are one-quarter of an inch in length by one-half inch. Remainder of healing perfect. No attempt was made at motion of the wrist or fingers. Present position of the hand and arm on the splint is shown in Fig. 6. Fig. 7

gives the position with fingers lightly resting on string, as it is not desirable to have any effort to contract sutured tendons made. Fig. 8 shows the greatest voluntary flexion.

Case XVI.—Gibney. Male, four years of age; admitted to the Hospital for Ruptured and Crippled, January 11, 1900, for right hemiplegia, equinus, and drop-wrist. Seven months ago the child had convulsions of the right side, including face, arm, and leg. This lasted one month. His hand and arm became paralyzed and flexed; toe-drop still continues. There is great weakness in muscles of the arm and hand. Was taken to a dispensary and electricity applied. January 13th right foot held in position of equinus. Able to extend it to ninety degrees, due to action of common extensor

Fig. 8.

Case XV.—Flexion of hand after operation.

and tibialis anticus; flexor muscles good. Wrist held at an angle of ninety degrees to forearm. The sublimis digitorum has good power. Fair power in the extensor communis. January 16th operation by Dr. Gibney. Incision two inches long over the extensor aspect of the wrist. Common extensor tendon exposed and loop taken in it, also one in the extensor longus digitorum and extensor longus pollicis. Sutured with No. 3 silk. Hand put up in hyperextension. February 10th plaster removed from hand. No power of extension in wrist. Can extend fingers fairly well. March 31st power in wrist but very slightly improved, although the position is better.

Case XVII.—Whitman. Male, twelve years of age; admitted to Hospital for Ruptured and Crippled, August 4, 1899. When

two years old the father noticed that the child's right side was partially paralyzed, but he never received any treatment. Examination August 5th showed that the child had right hemiplegia, with drop-wrist and inability to extend the hand; also slight hemiatrophy of the right side of the face. Marked atrophy and weakness of the right arm and hand. September 12th, under gas and ether anæsthesia, an incision two inches long was made over the dorsal surface of the wrist; the extensor carpi radialis longior and brevior were cut and shortened as much as possible. The divided ends of the tendons were sutured together by means of silk. Wound closed with catgut, hand put up in hyperextension. Wound healed *per primam*. October 17th incision on dorsal aspect of wrist, two inches long, over outer extremity of the right ulna and extensor carpi ulnaris was exposed and shortened as much as possible. To this shortened tendon was then fastened the flexor carpi ulnaris, which had previously been divided. Hand put up in hyperextension. Wound healed *per primam*. April 27, 1900, result is excellent. Patient is able to flex the fingers, flex and extend the wrist; although the hand is smaller than its fellow, it is very useful.

Vulpius[8] reports a case in which the flexor carpi radialis was made to perform the function of a flexor of the fingers. Several other cases are reported, but the details given are so scanty that it is not considered advisable to insert them. Vulpius[9] mentions in another paper that he has operated on three cases, but does not give the details. Hoffa[10] also reports three cases and gives full details.

The report of these cases shows clearly that we have at our command an operation which will do away with the necessity of physicians telling their patients that the best thing to do for a case of drop-wrist following cerebro-spinal meningitis is to amputate the arm; and that many patients who have heretofore been told that nothing could be done for their relief can be markedly relieved. The necessity for careful and thorough examination as to the condition of the various muscles prior to operation is a matter of considerable importance. We should ascertain whether they react to faradism, and whether the reaction of degeneration is present. To obtain good results with restoration of function it is advisable to suture only tendons that have power left if we expect these tendons to do active work in the future. Of course, the tendon to which

they are sutured is usually a paralyzed one, and the method of action is that the non-paralyzed shall do the work of the paralyzed one. Careful study of the various movements produced by the action of the muscles will tell us which tendons to transplant and to which they can be best attached. In addition there is no reason why muscles should not be made to do work for which they were never intended, and by certain arrangements so fastened that their usual line of action shall differ from the normal. In rare instances a paralyzed muscle might be transplanted, the idea being simply to use it to hold the hand or fingers in a better position without any expectation of restoration of function. Asepsis, of course, is very necessary, and if union *per primam* occurs there should be no adhesions to interfere with the movements of the muscles. To close the tendon sheaths is very difficult and probably unnecessary. Several small incisions are better than extensive dissections.

The question as to the proper material to use in suturing tendons seems to be of some importance, but all kinds of suture materials have been used with success. Most operators use silk for the reason that it is less liable to be absorbed, more liable to hold, and easier to use. Personally, I have used silk, catgut, kangaroo-tendon, and silkworm-gut, and in every case perfect union has resulted. The skin wounds have been closed with catgut, but this material, on account of its rapid absorption, is not recommended for suturing the tendons.

The question whether to cut the muscles across entirely in shortening them is one that has usually been decided in the affirmative, but personally I prefer to lap the tendon, so that in case of non-union the original tendon is left instead of a wide gap between the divided ends.

The method recommended of fastening the two tendons together is that of Goldthwait:[11] "The tendon to which the attachment is to be made is split and the end of the severed tendon, after it has been scored across to make the surface rough, is drawn through this slit and held by two quilted sutures. In this way both sides of the severed tendons become attached; and to offer a still greater area for adhesion the sutures are so placed that when tightened the outer tendon is spread out. The outermost suture is passed through both tendons and tied. The other is passed through the outer portion

of the split tendon, then through the free tendon from an eighth to a quarter of an inch away from the edge of the first tendon, then through the posterior portion of the split tendon and then back in the same way. When this suture is tied it spreads the outer tendon."

In the last case in which I operated I not only passed the tendons through one slit in the tendon of the other muscle, but, one and one-half inches below, passed it again through another, thus making two points of attachment. Sharpening or freshening the edges of the tendon that is to be slipped through is always advisable, and the slitting of the other tendon makes a raw surface with which it will unite. In Case XIV. the ends of the cut tendons were fastened between and to the other tendon, which had been folded back on itself for the purpose of shortening it.

Whether the dressings should be removed immediately after the operation is questionable. Even if they are removed I believe that the hand should be held in a hyperextended position for at least six weeks, so as to permit of a perfect tendon union, for the skin union must be more rapid than that of the deeper parts, and it is very important that the sutured tendons shall not be pulled apart. In my cases no motion had been permitted until six weeks after the operation, and then motions have been begun gradually and electricity and massage were used. Indeed, on the subsequent attention paid the case the ultimate result will largely depend. We may operate successfully, and yet, if we leave the case at this point, we have but half done our work, for the reason that the muscles must be educated in their new sphere of action and must be stimulated as far as possible.

Most of the operations so far performed have consisted simply in dividing tendons that were too strongly contracted and fastening them to other tendons which were too long or which were paralyzed. Future operators, I believe, will somewhat modify this procedure. It is very essential that the tendons which are too long should be shortened before the paralyzed tendons are fastened to them. But I believe that the procedure in regard to the cutting of the tendons which produce the deformity will differ somewhat from what it has been. There is no reason why we should entirely destroy the utility of these tendons by cutting them loose from their attach-

ments, because there are various methods of lengthening them,[12] and a tendon which is sharply contracted, if lengthened, might still continue to act and a portion of its power be given to another which does not properly act. In many of these cases the contractures are active, and yet the muscles on both the dorsal and palmar surfaces of the wrist will react to faradism and voluntarily contract, but the hand is so flexed that the power of the extensors is *nil*. Yet, if we divide entirely the flexors of the wrist, the future wrist flexion is done away with and can only occur secondarily after the fingers have contracted by the action of the deep flexors. In these cases it seems to me that it would be desirable to save at least one or more of the flexors. Whether the operative procedure will be to slip the tendons around the side of the forearm and fasten them together, or to pass them through the interosseous space, as has been done in one case reported by Rochet and in one of my cases,* can hardly be decided until more work has been done, but the slipping of the tendons through the interosseous space is not difficult and is worthy of trial. Numerous points of this kind will only be decided by actual experience in a larger number of cases than are so far to be found in literature.

The question of the future action of the muscle—that is, so far as the cerebral action is concerned—is an interesting one, and will be undoubtedly solved by the neurologist or physiologist. The practical point is that, with the flexor tendons attached to the extensors, when the patient wishes to extend the hand, the cases in which the operation has already been performed show that the proper motion results, although the extension is accomplished by contraction of flexor muscles.

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* At the time of the operation I was not aware that it had been done before, not having seen Rochet's article until three months later.

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DISCUSSION.

Dr. Joel E. Goldthwait, of Boston, said that he had not had an opportunity to operate on such a case as the one described by Dr. Townsend, and considered the result extremely satisfactory. It was but fair to report in this discussion the fact that three or four similar conditions had been operated upon with good results by simple division of the carpal tendons without attempt at transplantation, and following this by forced extension at the wrist for a considerable period. If, in a given case, it were not feasible to transplant the tendons, considerable improvement might be expected from the plan. If the tendons were to be transplanted, the more direct the route the better the result. He would certainly prefer the route taken by Dr. Townsend in going directly through the interosseous membrane, because in the foot where the anterior tendons had been made posterior tendons and carried around the leg the result had not been very satisfactory. This whole subject of tendon transplantation was most interesting and encouraging, so that now he was disposed to attack cases which a few years ago he would have considered practically hopeless. He would not hesitate to operate upon cases in which the muscle was comparatively weak. It was a matter of continued surprise to see how much a weak muscle would improve under the stimulus of use if used properly. It showed how much could be done in cases which at times seemed hopeless, and that even a little improvement meant a great deal to the patient. He referred to the case of a man of twenty-three, who, when a boy of thirteen, had had the tendon of the secondi

internodii pollicis divided. He was a musician, and he found it impossible to extend the joint so that he could strike the black keys of the organ obliquely. Although the case was not very promising, a longitudinal incision was made along the course of the tendon. The proximal end was not found. The distal end was found, and was in good condition down to the first joint. The cicatricial remnants of the tendon and sheath were then dissected out and fastened to the primi internodii pollicis, with the result that the man has almost absolute perfect extension. He has flexion enough to enable him to run his keys, and sufficient extension to add a whole note to his grasp.

Dr. L. A. Weigel, of Rochester, N. Y., said that there was a certain class of cases in which complete division of the tendons seemed to be an absolute necessity. He referred particularly to that class in which contractions from traumatic paralysis occurred. Within the last year he had seen two cases following fractures of the forearm. Both had been improperly dressed, with the result that there had been destruction of skin and nerve tissues. He had advised operative interference as offering the only hope of relief. He had made an incision at the wrist and divided every tendon encountered until able to extend the fingers perfectly. Both superficial and deep flexor tendons had been divided, but before doing so he had passed chromicized catgut through the tendon above and below and had cut between. He was satisfied in this case that if the tendons had been simply divided they would have united in a mass, and there would not have been the specialization of motion which was present now. A mechanical appliance had been put on to keep the hand in a position of hyperextension.

Dr. John L. Porter, of Chicago, asked how great had been the separation of the tendon.

Dr. Weigel replied that it had been about one and one-half inches.

Dr. E. H. Bradford, of Boston, said that in some of these cases that had been operated upon he had endeavored to avoid complete

division. He had done a myotomy by an open incision and divided the intermuscular septa, overcorrecting the hand. In that way the power of the muscle had been retained, and yet the contracted tissue had been overcome. He had operated on one hand by the method described by Dr. Townsend, and when last seen the child seemed to have gained.

A SIMPLE AND EFFICIENT TREATMENT OF TALIPES CALCANEUS PARALYTICUS IN YOUNG CHILDREN.

By V. P. GIBNEY, M.D.,
NEW YORK.

For a number of years in my own hands the treatment of calcaneus in young children was unsatisfactory, and my experience with the various mechanical devices had failed to convince me that one could reasonably expect a cure. The difficulty lay in the construction of an apparatus that would keep the foot fully extended at all times, without making such apparatus too cumbersome. The ordinary "reverse catch," which we have all had so much to do with, so frequently got out of order that I rather despaired of securing continuous extension, because time and again when this catch would get out of order, the foot-plate would break, or the shoe bend at the sole, and the patient would come in walking on the heel. Even in the hospital, where I was enabled to keep the appliance in reasonably good repair, it was exceedingly difficult to maintain continuous extension of the foot.

In thinking over the explanations given for the production of deformity in a paralyzed limb, I was convinced that long-continued position contributed largely to shortening of a tendon in a paralyzed muscle. For instance, the hamstrings would shorten, and even the muscles themselves about the hip would shorten. The writer has witnessed a number of cases where flexion deformity existed, and division of muscles or stretching must be resorted to before an apparatus for a paralyzed limb could be properly adjusted.

Case I.—Finally, in 1895, I had a little patient, aged eighteen months, whose parents wanted to spend the summer in Maine, and

although they were supplied with two or three braces the little fellow was so heavy that he would soon get them out of repair. I determined, therefore, to put his foot in extreme extension and maintain this position at all hazards, so I resorted to plaster-of-Paris. I explained to the parents fully the length of time which this plaster must be worn, and I provided a wedge-shaped piece of felting so that a shoe could be worn with comfort, thus enabling him to get about with a great amount of ease. This child had an attack of poliomyelitis in September, 1894. The lesion was not an extensive one, and there remained a paralysis of the gastrocnemius group and of the posterior tibial. It was on June 27, 1895, that my first observation was made, and, although I provided him with the appliance above named, on November 6, 1895, I found that the calcaneus was even more marked ; in fact, that the brace had done no good. I proposed an operation for shortening the tendo Achillis, but it was not accepted, and I determined, for the present at least, to put him in plaster-of-Paris, which I did on November 9th. It remained unchanged until December 7th. The tendo Achillis was perceptibly shorter. There were no excoriations when the plaster was renewed. It was reapplied at once and removed again on January 23d. The tendo Achillis was decidedly shorter, and the foot could be brought in dorsoflexion only to 90°. The plaster was removed on May 2, 1896, and again on June 1st, no excoriations at any time having appeared. At this date I made a movable cast which he wore to December, 1896.

A note which I find on November 2d reads to the effect that it was impossible to bring the foot in flexion to 90°. The tendo Achillis was not only short, but quite strong. I made him an apparatus at this time to correct the valgus, hoping thereby to secure some shortening of the posterior tibial. From this time I had no further trouble with the calcaneus. The apparatus was worn without any great strain, and it was easy to keep it in repair. From January, 1897, to March, 1900, I saw him from time to time, resorting to various measures to improve the posterior tibial, but without much avail. He developed an equino valgus. Even without his apparatus he would walk, and yet the tendo Achillis would remain short. I determined, therefore, to do some tendon graft-

ing, and on March 30th I made a long incision in front of the ankle, toward the inner side, exposing the tendons of the posterior tibial, anterior tibial, the flexor brevis pollicis, and the common extensors. I detached the flexor brevis pollicis from its insertion and some tendons of the common extensors, and passing these ends through the button-hole in the posterior tibial, just in front of the malleolus, fastened them with fine silk. I then dragged over the larger portion of the common extensor to the inner side and tied these to the posterior tibial with kangaroo tendon. Even under the anæsthetic I was unable to *stretch the tendo Achillis* so that the foot would stand at right angles with the leg. I did not care to divide the tendon, but thought at the next dressing or so I should be able to complete the extension. This proved true, and on April 12th, less than a month after the operation, I succeeded in stretching the tendon, so that the foot was brought quite to 90°. It was interesting to note how strong and large the tendo Achillis was. The result of the operation thus far is very good. He has now practically a normal foot. He can make flexion and extension without this annoying eversion of the foot. I have no fear whatever of any trouble with the original deformity, viz., calcaneus.

Case II.—A girl, aged five years, came under my observation on January 27, 1898. Her attack of poliomyelitis was in July of that year, but a marked atrophy and the deformity did not begin until some time in October or November. I found the tendo Achillis quite long. The foot and leg were cold, the child, as she walked, used the heel. I obtained such excellent results in the preceding case that I spent considerable time in explaining to the parents the necessity for the treatment I proposed to adopt. This was the plaster-of-Paris in complete extension, and it was continued unremittingly, changing the plaster every three or four months until the fall of 1899, over a year and a half. It was interesting to note the development of the tendon, and even of the calf, in spite of the plaster-of-Paris. There was fully one inch difference at the time. Now there is scarcely one-half inch. She is wearing a little ankle support and has a foot that is just about normal.

There are still under treatment two unfinished cases, but the result is already apparent, and from my experience with those just reported I feel assured that the final result will be equally good.

Case III. was a girl, aged three and one-half years, from Cleveland, Ohio, whose poliomyelitis came on when she was fifteen months of age. It was many weeks afterward before she was able to use the limb. When I saw her on March 16, 1899, she

Case III.

walked with a marked calcaneus limp, striking the heel first. The right limb from the anterior superior spinous process measured seventeen and three-quarter inches ; left, eighteen and one-quarter ; from the umbilicus, right side, nineteen and one-quarter inches ; left, twenty and one-quarter ; thigh, six inches from the anterior superior spinous process; right side, nine and three-quarter inches ; left, ten and one-half. Right knee, eight inches; left, eight and one-half ; right calf, six and one-half inches ; left, seven and one-half. The foot was one-half inch shorter than its fellow, and

over the instep there was a difference of three-quarters of an inch. The outline of the foot in March, 1899, is shown in Fig. 1; February 19, 1900, in Fig. 2. Fig. 1 shows the position in which the foot naturally rested. Fig. 2 was the best dorsoflexion I could make without the employment of great force. As she attempted to make dorsoflexion the great toe was drawn in trigger-toe and she could not quite reach 90°. There was a little tilting of the pelvis, but no spinal curvature. The mother was very incredulous when I proposed the plaster-of-Paris treatment, and it was only after considerable argument that she consented to this treatment. She remained a few days in the city to see that the toes did not swell too much, and it was necessary to apply a second one before I got the toes and ball of the foot properly protected. The mother wrote me in June, and the letter was simply a record of the child's daily life, how well she got about, and how little discomfort the plaster caused. I did not see her from March 21, 1899, until August 14th, nearly six months, when I removed the plaster, finding a little excoriation at the base of the toes, dorsal aspect, none elsewhere; the improvement was at least 50 per cent. The comparative measurements showed one-half inch increase in the length of the limb, no increase in the size of the thigh, a loss of one-half inch in the circumference of the calf. The plaster was reapplied, and on February 16, 1900, nearly a year from the beginning of the treatment, the tendo Achillis was quite strong and the equinus had entirely disappeared. It was at this time that tracing No. 2 was taken. The thigh had increased a full one-quarter of an inch, the calf remaining the same as in August. I decided to put on a third plaster bandage, which she is now wearing. I feel that I shall be able to omit all dressing of this kind during the early summer.

Case IV.—This case was a boy, aged three and one-half years, who came under my care October 17, 1899, with a marked calcaneus, his poliomyelitis developing in July, 1898. The fever was of sudden onset, and it was eight or ten days before a diagnosis was made. The child screamed almost continuously, and it was found at the end of this period that his left leg was paralyzed, his right arm partially so. Two or three months later he began to walk.

All at once the right arm recovered, and for the past three months he has been walking on his heel. The right ankle measured eight inches, the left seven. The quadriceps extensor did not act well, while the thigh itself was one and one-half inches smaller than its fellow. I put him under the same course of treatment, and the plaster was removed for the first time on February 27, 1900. I found the gastrocnemius muscle very sensitive, and it was difficult to extend the tendo Achillis. The position of the foot was excellent. The plaster was at once reapplied, and he is still under treatment.

These four cases are presented in evidence of the efficacy of prolonged and uninterrupted extension of the foot.

I have not resorted to the method in the older patients, for the reason that it is difficult to keep plaster-of-Paris on a limb sufficiently long to secure a good position. I have not employed water-glass, nor have I attempted leather splints in these young children. I am now employing a leather splint, reinforced by steel, in front, for an adult, and it gives me much pleasure to add to this short paper and report an exceedingly interesting case.

Case V.—*Metatarsalgia, depending apparently on hysterical equinus, division of tendo Achillis, subsequent elongation of same, with a most persistent equinus resulting, finally relieved by prolonged extension.*—A lady, aged thirty-five years, came under my care September 29, 1896. She had suffered for a long time with metatarsalgia, and had been under the care of two distinguished surgeons in Philadelphia. At the time I saw her the pain was referred to the distal ends of the second and third metatarsal bones. There was a moderate amount of flat-foot, but the tendo Achillis was short and I could not flex the foot to 90°. There was no pain on pressure between the fourth and fifth metatarsals. I ordered a shoe built on Spanish last, in order to correct the flat-foot, and I had the heels rather high, so that there would not be any strain on the tendo Achillis. Two months later the shoes were comfortable, but there seemed to be too much pressure against the arch of the foot. She herself, a trained nurse, had long since got the impression that her tendo Achillis was too short, so in the latter part

of December, 1896, she asked my permission to have a surgeon in a suburban town divide the tendon. I offered to make any suggestions to the surgeon if he so desired. A few days later, in response to a letter from this gentleman, I wrote him, giving in detail the steps of the operation, the subsequent management, etc. I insisted on a great amount of care in the management of the tendon, as I was afraid that she would abuse his treatment and get the tendon too long. On April 14, 1897, she reported herself perfectly free from her metatarsalgia, and gave this history: The operation had been done as instructed, the foot was put up in plaster-of-Paris, but she removed it in a few days, because of the development of gout. A brace was employed at this time and worn not very regularly. I found the tendon quite small. It was too long, and there was a transverse depression into which one could put the finger, just near the point where the tendon joins the muscle. There was increased atrophy of the limb since the operation. I naturally felt that I could not be responsible for this condition, and advised that she keep the foot extended as much as possible and prevent dorsoflexion at any time. I saw very little of her during that year. On April 12, 1898, she told me that she had been very weak since the operation, and I found a very marked calcaneus. Indeed, there was scarcely any of the tendon left. She had a good deal of spasm of the flexors of the toes, and I finally urged the plaster-of-Paris with the foot extended. In the meantime, however, I had a wedge-shaped piece of cork inserted in the heel of the shoe. Shortly afterward I applied a water-glass bandage, and while the water-glass was setting under the plaster she became quite hysterical, and the bandage had to be removed. On July 19th and 23d these were repeated with the same results—that is, great pain and objection to wearing any hard splint. It required a great amount of persuasion to induce her to continue treatment of this kind. In August, 1898, there was evidence of increased growth of the tendon. I was obliged to employ a brace at this time, but under protest. On February 8, 1899, there was still a marked calcaneus, but she managed to get about fairly well with the apparatus. The toes annoyed her a good deal, and on April 21, 1899, under ether, I divided the tendons of the flexor brevis pollicis and the common extensors, sub-

cutaneously, and secured complete extension of the toes, in fact brought them into flexion. The foot was likewise extended and plaster-of-Paris employed from the tips of the toes to the upper part of the calf, avoiding all pressure over the tendo Achillis. She was in the hospital at this time and I could command better discipline. Within two or three weeks, however, she developed another hysterical attack. Her stomach "gave out," and I was obliged to resort to water-glass again, which she wore until August, 1899. Then I took a cast of her foot and had a leather splint made, reinforced well in front, with the foot in pretty sharp extension. So the case progressed. My last observation was on March 23d of the present year, and found at this time a pretty strong tendo Achillis. In fact, it was just about normal. This depression had just about disappeared, and she was able to flex and extend the thigh with great ease. I saw her at this time in conjunction with Dr. Joseph Collins, who injected strychnine hypodermatically into the calf muscles as a remedy for her neurasthenia. The result on the whole, therefore, is excellent. It has been a most exasperating case in many respects, yet by persisting in the treatment I am able to report so favorably. In conclusion, I may say that most any appliance which is worn night and day, the management of which is taken completely out of the patient's hands, should bring about like results.

My fondness for plaster-of-Paris has prejudiced me in its favor, and yet I can readily see how any other dressing which will meet the indications could be employed with equal advantage.

DISCUSSION.

Dr. Newton M. Shaffer, of New York, asked if the gastrocnemius group had been tested with the faradic current before the application of the current in order to determine the amount of power.

Dr. Gibney replied in the negative. That there was paralysis of the muscle was inferred from clinical experience.

Dr. Shaffer said this was an important point, because the restoration of the muscle under the circumstances seemed quite remarkable.

Dr. L. A. Weigel, of Rochester, N. Y., said that in some cases of complete paralysis with much trophic disturbance there was some danger from excoriation. He had had an unfortunate experience of this kind. To retain the foot he had taken a piece of adhesive plaster and strapped up the leg. In the course of twenty-four hours an ulcer had formed, and this had remained unhealed for ten or eleven months, and finally necrosis of the os calcis occurred. The foot was still in the calcaneus position, for the reason that there was no form of dressing which could be applied to this case without danger of gangrenous ulceration taking place.

Dr. John Ridlon, of Chicago, said that the paper dealt chiefly with the use of plaster-of-Paris and the gain in function from prolonged and constant retention. If the latter were claimed as a new idea it was an error. For many years the late Hugh Owen Thomas had treated all his cases of this kind by extension and retention. This surgeon claimed that it was entirely possible to get a return of function in all muscles which were not wholly paralyzed, but only apparently paralyzed, if the muscles were placed in a position of relaxation, and that they did not get that if kept in a condition of tension. He used a shoe with a wedge sole, two inches and a half thick at the heel, and thin in front, and reinforced by a bar of iron extending two-thirds the length of the shoe, and up the back of the leg to the calf. The apparatus is very simple though decidedly clumsy.

Dr. H. P. H. Galloway, of Toronto, Canada, said that Dr. Gibney had referred to the occurrence of valgus after shortening of the tendo Achillis, and he felt that this would occur very frequently under these circumstances. His attention had been called to this matter several years ago by a case of slight paralytic equino varus in which the only treatment had been the raising of the outside of the shoe slightly. The patient had returned within a month, and

at that time he found that the case had been converted into an equino valgus from an equino varus. He had also observed the reverse change. There seemed to be a class of cases in which the shortening of the tendo Achillis would cause either supination or pronation according to the direction the foot happens to be given by accident or by treatment.

Dr. A. B. Judson, of New York, said that he had been in the habit of treating these cases mechanically. By pursuing the course which leads to the utmost simplicity his results had been satisfactory. The cases were treated from infancy and in a purely mechanical way. In the construction of the brace he omitted motion at the ankle for one thing, and in this way secured greater durability of the apparatus. The first effect of an apparatus of this kind was that the weight of the body, which should be carried on the anterior part of the foot by virtue of the strength of the muscles acting on the tendo Achillis, is transferred to the anterior surface of the upper part of the shin, where, in the course of time, a painless callus forms, and not infrequently an adventitious bursa. It was extremely satisfactory in a child so affected to treat it by this mechanical method, as the gait was at once improved, and one noticed as the child grew older that it became greatly attached to the apparatus. In cases in which there was extreme calcaneus —where there was practically no tendo Achillis—the gait could be made absolutely perfect if managed in this way. This was an example of the successful use of prothetic apparatus.

Dr. Gibney said that he had had so much to do in former years with the electrical tests of muscles and had been so intimately associated in later years with electrical experts and neurologists that he had learned to place very little weight upon the examinations made in this way in young children. It was very common for him to refer a young child with dangle leg to the neurologist, and have him report that the child was so irritable that he could not determine whether or not there was a reaction of degeneration. On the other hand, it seemed to him that even with comparatively little experience one should be able to diagnosticate poliomyelitis without the aid of the electric current. He was willing to have his

cases go on record as examples of poliomyelitis. Whether all of the fibres of the affected muscles were absolutely paralyzed or not he did not know, nor did he particularly care. At the present time he very rarely resorted to these electrical tests. He was also familiar with Mr. Thomas' method of treating apparent paralysis and paralyses. For instance, he called "drop-wrist" paralysis of the extensors. Whether it was true that the muscle that is paralyzed is bound to be always paralyzed was a matter largely of individual judgment and opinion. If the child has a useless limb, and is walking on its heel, and we know by experience it is likely to do so all its life, it made very little difference whether the condition was called paralysis, apparent paralysis, loss of tone, or what not. He was not proposing anything new, but had simply described an efficient way of securing what he considered to be good results. The trouble he had had with the abolition of the joint at the ankle was that the apparatus had been made so cumbersome that it was difficult to prevent it from breaking easily. He did not think that the occurrence of callosities or bursæ on the shin was particularly desirable, especially if they have to be carried a great many years. He had mentioned plaster-of-Paris as only one of the means that might be employed to bring about the desired results.

A CASE OF TUBERCULOSIS OF THE ANKLE PRIMARILY INVOLVING THE SOFT PARTS.

By V. P. GIBNEY, M.D.,
NEW YORK.

Presentation of the Specimen, with Microscopic Findings. A girl, aged twenty years, admitted to the Hospital for Ruptured and Crippled, February 16, 1900, for the relief of disease of the right ankle. The family history was negative. Personal history uneventful. Five years prior to the date of admission she sprained her ankle while walking. There was considerable pain at the inner side at the time, and the joint soon began to swell. Under the ordinary treatment for sprained ankle she made very slow progress, and the swelling and disability has continued. She was in plaster-of-Paris for a month, but the pain was so great that a brace was substituted, and this was worn for about two months. At the end of this time the pain was relieved, but the swelling continued. She wore stiff shoes, thinking that it was only a question of time before recovery would be complete. She limped, however, and in December, 1899, the brace was applied on account of pain in the ankle. Crutches were employed, and at the time she appeared at the Vanderbilt clinic, in the early part of February, an X-ray was taken, which revealed a fringed astragalus. The other bones of the foot seemed to be perfectly normal. The space about the astragalus was enlarged, and it seemed very evident that the disease was confined to this bone, hence her admission to the hospital for its enucleation. The pain which she suffered was confined to this bone, and extended over the internal malleolus There was none elsewhere. There was the usual reflex

spasm on flexion and extension, enlargement, extra heat, atrophy of the calf, etc.

On February 20th, under gas and ether, an incision was made over the head of the astragalus, large enough to enable me to remove this bone. On getting through the soft parts there ap-

FIG. 1.

peared a jelly-looking mass, darkish looking in color, and in quantity about an ounce. It looked like material known as tuberculous. The bone was easily removed, the parts for at least a quarter of an inch beyond the cavity cut away, and it seemed that an absolutely clean operation had been done. A counter-opening was made just above the heel for a few days' drainage. The ante-

rior wound was sutured closely, and sterilized dressing and plaster-of-Paris completed the procedure.

All went well for four or five days, then the pain returned, her temperature increased, and it was found necessary, on March 22d, to make an incision over the internal malleolus on account of

FIG. 2.

Lesion in lower epiphysis of tibia.

an abscess. The history, from that time to April 28th, was simply extension of the suppuration, abscess after abscess in all parts of the foot, incision, drainage, etc. Her health became critical, and on the 29th amputation was done at the junction of the middle and lower third of the leg. She made an uneventful recovery.

Dr. Jeffries, the pathologist to the hospital, makes the following report: The astragalus removed at the first operation contained numerous small foci of tubercular tissue. The tibio-os calcis articulation was incompletely ankylosed, and the articular cartilages of this joint were roughened and showed tuberculosis.

Microscopical examination failed to discover any further lesions until the head of the tibia was cut through. Here tubercular softening had extended from the articular surface upward into the cancellous tissue, extending nearly the entire width of the bone, fifteen millimetres upward at the deepest portion. Microscopical sections of this tissue demonstrated its tubercular character, and no conclusions were arrived at as to whether the lesion had extended from above downward or in the opposite direction. Microscopical examination was further made of tissue selected from the head of the fibula and from points in the cancellous tissue, about the centre of the head of the tibia. That from the fibula proved entirely negative. One or two small foci of an inflammatory character were found in the tibia, but their tubercular character could only be assumed.

The tissue about the astragalus, the pathologist informed me, was distinctly tuberculous, and the bone itself did not contain the usual centres of softening, but the disease was confined to the periphery. He had no way of demonstrating, as was seen from above, an original focus in the tibia or fibula, extending down to the joint, and the fact that her pain had all been confined at first to the region of the astragalus would make it more than probable that the disease was primarily synovial.

Dr. Goldthwait, of Boston, exhibited in this connection water-color drawings from a case of excision of the knee. The case had been treated conservatively for one year, but had grown steadily worse. Excision was then performed. On opening into the joint the tissues all about the incision were found infiltrated with tubercular material, some of the fringes hanging down two inches or more. Careful search has failed to show any focus in the bone. The result of the excision was good.

RESULTS IN CORRECTING THE KYPHOSIS OF POTT'S DISEASE OF THE SPINE.

By V. P. GIBNEY, M.D,
NEW YORK.

The results here presented represent the efforts at the Hospital for Ruptured and Crippled made to obliterate the kyphosis or to reduce the deformity to the minimum. No one can question the possibility of obliterating this offensive gibbus, because the testimony already afforded is incontrovertible. It has already been demonstrated that with ordinary care enough force, manual or mechanical, can be employed with reasonable safety—*i. e.*, without immediate fatal results. The inflammatory thickening of tissue in front of and around the foci of disease enables the surgeon with even a limited knowledge of the pathology of Pott's disease to regulate the force employed at a single operation. By repeating these operations, preferably without anæsthesia, the gradual obliteration can go on with comparative safety. The necessity for employing the terms "reasonable" and "comparative" excludes the operations of Calot from the category of safe procedures.

Until the operation is regarded by conservative surgeons as hazardous the practice will surely continue. This contribution is a discussion of the means of retaining what reduction is accomplished at the various stages of the treatment. I may say, incidentally, that the forcible correction of the gibbus under an anæsthetic has not become a popular measure with the surgeons in attendance at the hospital I represent on this occasion. Hence the limited number of cases presented for study out of so many coming under observation in both in-patient and out-patient departments.

Nine patients carefully noted have been subjected to the Calot method, and it may not be amiss to briefly narrate the cases:

Case I.—A lad, aged twelve years, admitted to the hospital in January, 1898, had a lumbar Pott's of long standing, but the convalescence had been slow and interrupted by provoking exacerbations.

A plaster-of-Paris jacket was applied in the swing, and the tracing showed a gibbus 2 cm. in height on a chord of 15 cm. Under the jacket the deformity was reduced, as shown by tracing, 0.5 cm.

The usually described bone-breaking sensations were imparted to the hands of the operator during the operation, and the back

Tracings 1.

Case I.—1. Before operation. 2. Just after operation. 3. October 19, 1898, six months later.

was made quite straight, but the tracing did not show complete obliteration. The measurement was 0.5 cm., and after two or three jackets this remained in October, 1898. When the second jacket was applied a psoas abscess was discovered, but this proved harmless and ultimately disappeared without interference. Although the last tracing was in October, the boy has been seen from time to

time among the out-patients, and I am assured that there has been no increase in the gibbus. There has been a gain, therefore, of 1.5 cm.

CASE II.—Boy, aged six years, on admission in June, 1896, gave a history of a dorsal Pott's, with compression paraplegia, which disappeared under the usual protection treatment. At the

TRACINGS 2.

CASE II.—1. June, 1896, and March 7, 1898, before operation. 2. March 7, 1898, just after operation. 3. September 15, 1898, and October 4, 1899.

time of operation (after Calot) he was convalescent, and his was regarded as a perfectly safe case. The gibbus occupied the mid-dorsal region. Under plaster-of-Paris we succeeded in preventing deformity from June, 1896, to March 7, 1898, as will be seen by the tracings. The operation was under ether, and no accidents

were encountered. The plaster-of-Paris immediately afterward was carried up over the shoulders to the occiput, and he remained in bed two or three weeks. The plaster proved to be poor, and

TRACINGS 3.

CASE IV.—1. Before operation. 2. After operation.

during the following eight months we found a little increase as new jackets were applied. It must be noted, however, that about two months after operation he developed measles, and the support was very inefficient.

In January, 1899, we began the use of the Goldthwait apparatus for correcting without an anæsthetic, and were unable to effect any reduction. With a rotating staff we were unable to prevent any deformity, and now at the end of two years he presents an increase of 0.25 cm. in the height of the gibbus.

Case III.—A boy, aged ten years, was operated upon in May, 1898, for correction of a gibbus in upper dorsal, associated with an incomplete compression paraplegia. The deformity was not perceptibly reduced, as shown by the tracings before and after, yet on the following day a most marked improvement was observed in the power of the limbs. On the third day scarlatina developed, and within a week he died. No autopsy was allowed.

Case IV.—A girl, aged five years, had a Pott's of three-years' standing and a bosse in the dorsal region, as shown by the tracing, a little over 4 cm. in height. Under an anæsthetic, July 28, 1898, the bosse was reduced by manual force, and sufficient care was not taken in applying the plaster-of-Paris bandage, for on its removal, ten days later, four deep excoriations made further retention treatment not specially efficacious. The fenestra allowed during the repair of the tissues a recurrence of the deformity to a slight extent. The case soon passed from our observation, and I am obliged to report it as incomplete, although at the time of last tracing there was a gain of about 2 cm.

Case V.—A girl, aged five years, with dorsal Pott's of three-years' standing and a gibbus of large size (3.5 cm. in height—tracing shown), was subjected to Calot on August 2, 1898, and deformity reduced (see tracing), so that 1.40 cm. represented height of bosse. The child developed pertussis, and on removal of the plaster-of-Paris, August 17, 1898, the tracing showed recurrence to a marked degree—the height 3 cm. This gain, then, was about 0.5 cm. At this time the Goldthwait frame was employed, but no further recession was accomplished. This case is an illustration of the difficulty of holding what was gained.

Case VI.—A girl, aged six years, with dorsal Pott's of eighteen months' standing, and gibbus quite marked, but not exaggerated,

was subjected to Calot, August 10, 1898, without any effect on the deformity. Six weeks later, under a jacket in bed, no reduction

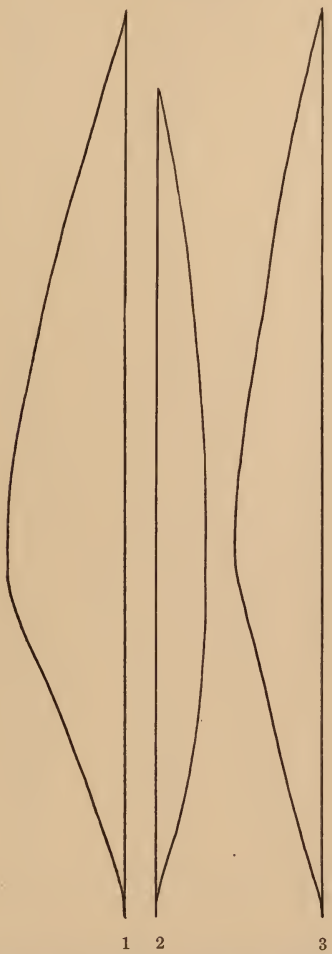
TRACINGS 4.

CASE V.—1. July 25, 1898, just prior to operation. 2. After operation. 3. August 17, on removal of jacket.

could be noted. A Knight spinal brace was applied and the patient discharged. Result in this case negative.

CASE VII.—A boy, aged four years; disease confined to the mid-dorsal and lower dorsal, of seven months' standing; presented a marked gibbus, as shown by tracing.

TRACINGS 5.

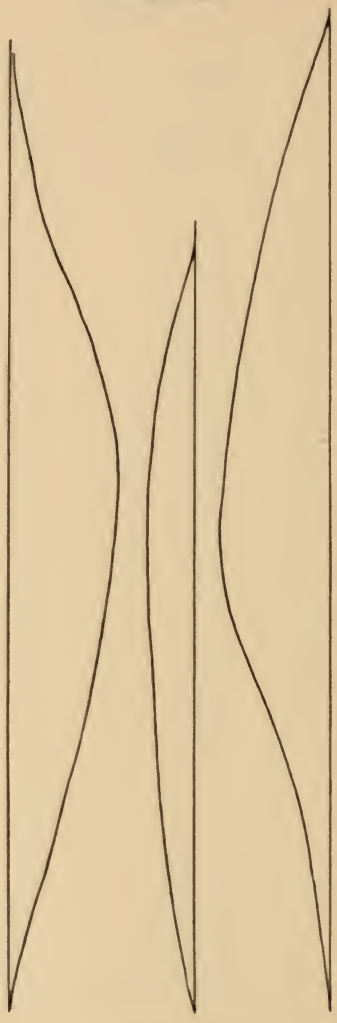


CASE VII.—1. August 2, 1898, before operation. 2. Just after operation. 3. August 30, 1898.

Under ether, August 2, 1898, correction was made to the extent of over one-half, as seen in tracing. Much care was taken in securing a jacket that fitted well, and yet at the end of the month

the deformity had recurred to nearly the normal proportions. No further attempts were made, but a convalescing corset was fitted and the patient discharged.

TRACINGS 6.

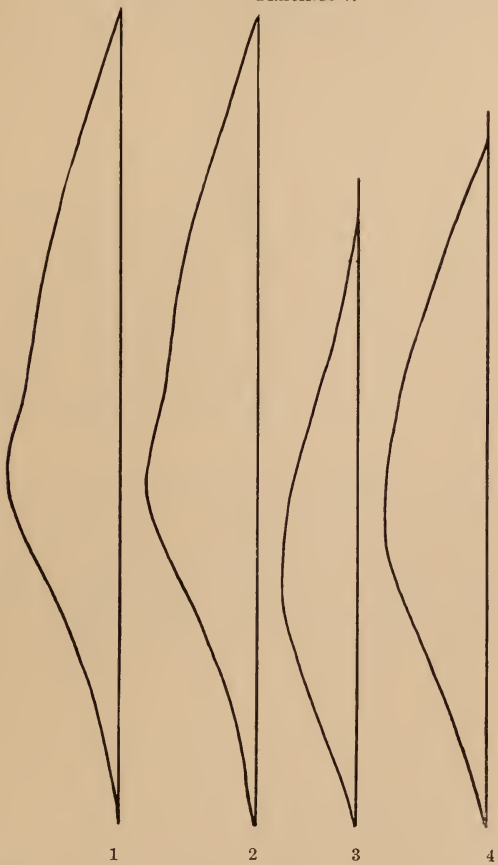


CASE IX.—1. Before operation. 2. Just after operation. 3. Three weeks after operation.

CASE VIII.—A boy, aged seven years, with dorsal Pott's of over two years' standing and paraplegia of about four months'

duration, was subjected to operation, October 1, 1898, and the notes record reductions of the deformity, although no tracings can be found. No relief was afforded the paraplegia, and on December 3d of same year a jacket was applied with the patient extended on a Goldthwait frame. Marked relief was very soon thereafter

TRACINGS 7.



CASE X.—1. Before operation. 2. Just after operation. 3. Three weeks after operation. 4. Five and a half months after operation.

observed in the use of the limbs, and in February, 1899, less than two months afterward, he was walking.

CASE IX.—A girl, aged five years, with paralysis affecting one limb, resulting from a poliomyelitis four years before, and a dorsal

Pott's of one year's standing, was operated on, August 1, 1898, for the correction of a deformity, as shown by the tracing here presented, and although reduction was fully two-thirds accomplished, recurrence took place under the plaster. The last tracing taken three weeks after the operation shows practically no gain.

Case X.—A girl, aged five years, had a rigid bosse in the dorsal region and a paraplegia on admission, June 9, 1898. She was put under weight and pulley in bed, securing extension and counter-extension, but at the end of five weeks no improvement could be detected. The tracing, July 14th—at time of operation under ether—is here presented, with that taken immediately afterward, showing very little effect on the bosse; that taken three weeks later showing decided recession, and that taken at the end of five and a half months showing a final gain of only 0.5 cm. Seven days after operation, however, she could voluntarily move the feet and legs, demonstrating the relief given the paraplegia. Two weeks subsequently she developed bronchopneumonia, but the improvement in power of the limbs continued. A convalescing brace, with a head support, was applied, and the case passed from observation.

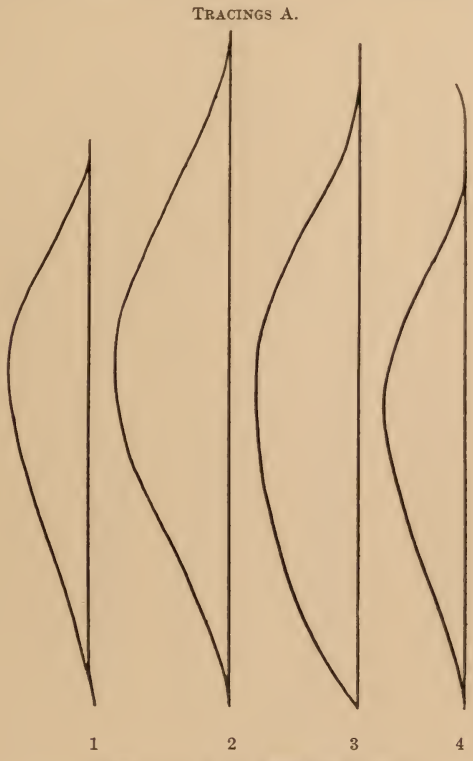
The ten patients subjected to operation fared as follows: Five gained in recession of deformity from 0.40 to 2 cm.; one had an increase of 0.40 cm. in the bosse; four remained in *statu quo ante*. In every instance where compression paraplegia existed as a complication more or less improvement was observed so soon after the operation that the relationship of cause and effect cannot be questioned.

Ten Cases Treated after Goldthwait.

The frame employed by Dr. Goldthwait has been fully described in preceding numbers of the Transactions, hence I shall omit a detailed account of this most efficient method of securing a leverage action on the spinal column with the fulcrum at the apex of the bosse. All the dangers of suspension are avoided, and in my own practice the dread on the part of young children is no longer observed; they can be made very comfortable in the recumbent posture, and the surgeon can take his time (in fact, the more time taken the more recession secured) in rolling the plaster bandages

about the body, having no excuse whatever for failing to make an artistic jacket.

CASE I.—A girl, aged four years, in June, 1898, presented, on admission to the hospital, a deformity as shown in No. 1 of Tracing A. The effort at reduction on the frame was not made until October 20th, when the bosse was identical with that on admission. Four jackets were applied in this way to February 20, 1899, and



CASE I.—1, 2, 3, 4. From left to right.

it will be observed by reference to the tracings that on removal of the second jacket the bosse was decidedly larger; that it was smaller on removal of the third, and in was in *statu quo ante* when the last tracing was taken.

CASE II.—Boy, aged six years, presented a deformity in the dorsal region, as shown by Tracing 1, in Series B, October 27,

1897. The special treatment now under consideration was not begun until December 3, 1898, when Tracing 3 showed a little recession as compared with No. 2. On applying a second jacket in the same way, December 14th, less than two weeks later, there was found decided improvement (see No. 4); but on February 22,

From left to right.

Case II.—1. October 27, 1897. 2. July 2, 1898. 3. December 3, 1898. 4. December 14, 1898, and February 22, 1899.

1899, there was found a marked increase, and the final result was a gibbus 1 cm. higher than on admission to the hospital.

Case III.—Girl, aged six and a half years, on admission, August 15, 1898, presented a marked gibbus in the upper dorsal

(see No. 1, Tracing C) of three-years' standing. Paraplegia, very nearly complete, made a perfect picture of a helpless cripple. The usual plaster jacket and head spring were worn until November 14th, when an attempt was made to correct the deformity. The Tracing No. 2, taken two weeks later, shows an *increase* of the bosse; but a second attempt was made at this time, with

TRACINGS C.

From left to right.

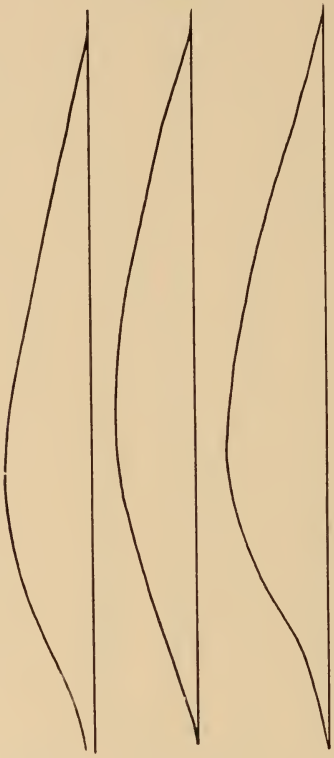
CASE III.—1. August 15, 1898. 2. November 28, 1898. 3. December 15, 1898. 4. November 23, 1899.

happier results, as shown by Tracing 3, taken December 15th. There was noted a decided change for the better in the power of the limbs, and this improvement continued without interruption. She was able to walk when the second tracing was taken From this date to March 15, 1899, the jackets were reapplied less frequently, and the case got on so well that our interest waned. She began walking poorly, and quite suddenly developed a septic endo-

carditis and pericarditis. In three months recovery was complete, and the weakness in the limbs had disappeared. The deformity seemed to be in *statu quo*.

In February, 1900, she varied the monotony by coming down with a pretty active pneumonia, from which in due time she recov-

TRACINGS D.



CASE IV.—1. Before frame. 2. After frame. 3. After suspension.

ered, to have again a paraplegia. This was of short duration, the extension on the Goldthwait frame affording relief. No other complication arose, and she was discharged in excellent condition in April of the present year. The tracing No. 4, taken November 22, 1899, shows a gain of 0.5 cm. over that taken on admission.

Case IV.—Boy, aged six years, with mid-dorsal of two-years' standing, presenting a gibbus (see No. 1, Tracing D), was treated by the frames in November, 1898, after nearly a year's treatment

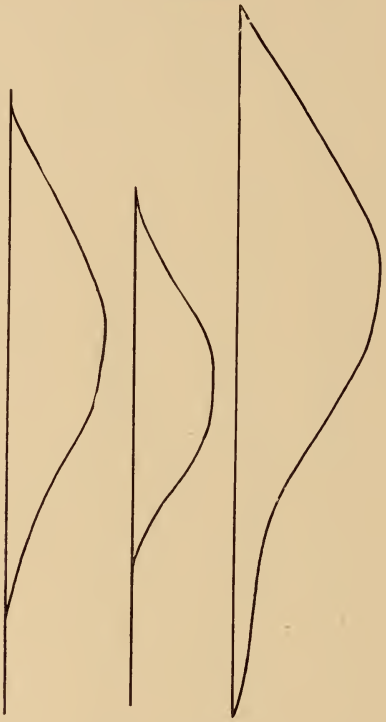
Tracings E.

Case V.—1. After using Taylor brace. 2. After partial suspension with jacket. 3, 4, and 5. Treated by Goldthwait frame. 6. Convalescent period.

by jackets in suspension. An appreciable *gain* in correction was noted. Later the suspension apparatus was used, and at the next tracing the deformity was found to have *recurred.* (See tracings.)

Case V.—Boy, aged three and a half years, admitted to the hospital October 7, 1897, with dorsal Pott's (see No. 1, Tracing E). He wore a Taylor spinal brace, which was soon replaced

Tracings F.

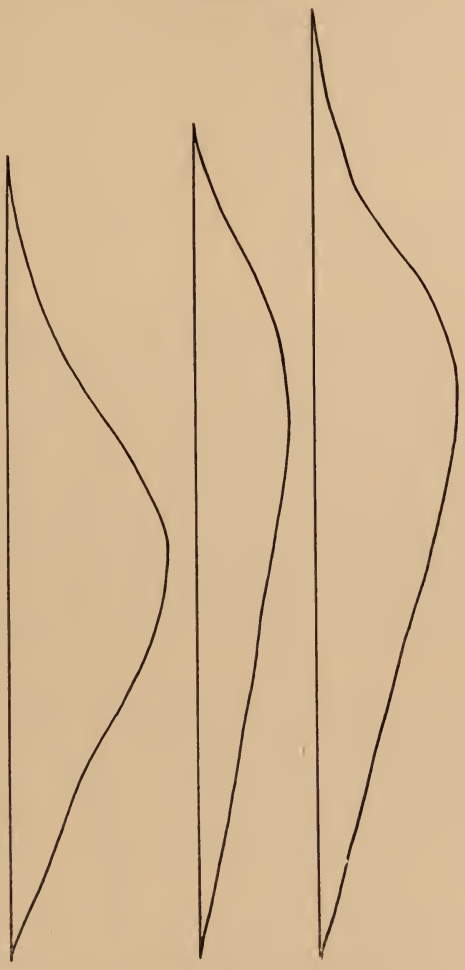


Case VI.—1. On admission. 2. After first treatment on frame. 3. Final result.

by a plaster jacket and head springs while partially suspended. The deformity was not specially affected until the following June, when Tracing No. 2 indicated a bosse shorter, but now less prominent at apex. In September the frame treatment was begun, but, as will be seen by Tracings 3 and 4, the bosse changed very little until November 16th, when Tracing 5 was taken; then the back

was practically straight. During the next ten months the case was not followed closely, as the boy was in the country most of

TRACINGS G.



CASE VII.—1. September 22, 1898, before. 2. March 6, 1899, early result. 3. August 16, 1899, late result.

the time. The last tracing, No. 6, taken August 10, 1899, shows a marked increase in deformity. He had several men, differing

as to merits of the methods, in attendance, and the result is conspicuously bad. I hate to place this case on record.

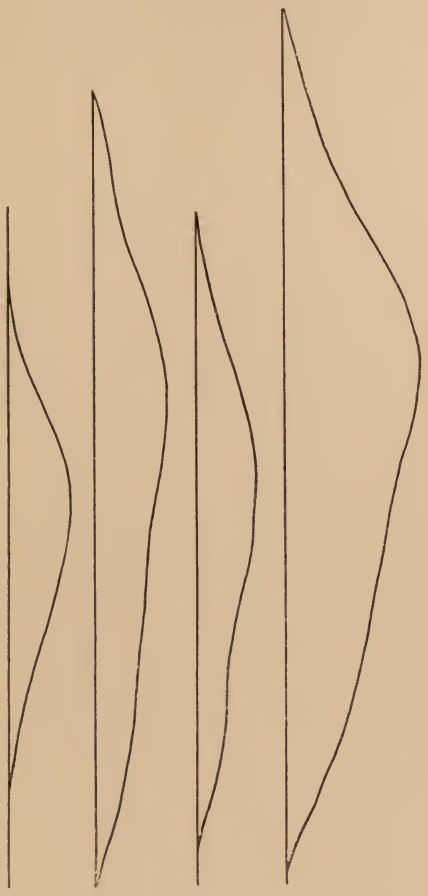
Case VI.—Girl, aged six years; dorsal Pott's (deformity shown No. 1, Tracing F); disease of two-and-a-half years' standing. For two years prior to treatment by the efforts at reducing the bosse there was no change in the deformity, and the case bade fair to remain in *statu quo*. Curiously enough, as soon as the adhesions were loosened by the leverage action of the body the bosse began to increase—*i. e.*, the immediate result showed gain, while the ultimate result (see Tracing No. 3) showed loss. This tracing was taken one and a half years later.

Case VII.—Girl, aged ten years, for five years afflicted with dorsal Pott's, and presenting on admission, September 16, 1898, a deformity as shown in Tracing No. 1 of Series G. Many jackets were applied with the patient on the frame, and the tracings for six months led us to believe that marked recession would be accomplished. One (No. 2), taken March 6, 1899, showed a gain of about 50 per cent., while that taken five months later (No. 3) was very discouraging. The sum total of gain in apex was less than a half centimetre. She was at one time nearly completely paraplegic, and the extension of the column soon brought relief.

Case VIII.—Boy, aged five years, with dorsal Pott's and the resulting deformity, as seen in Tracing No. 1, Series H. This case is illustrative of the changes that may be noted in the advances of the bosse where profound compression myelitis complicates. We had no difficulty in effecting marked recession, as seen in Tracing No. 3, but it was impossible to maintain any retention appliance long enough to insure a good result. Bed-sores would form on the slightest provocation; the incontinent urine would soil the dressing, and we finally had to keep him in horizontal suspension on a hammock. I present these tracings because the paralysis is disappearing, bed-sores no longer appear, and the outlook is very good. Tracing No. 4 was taken August 9, 1899, and shows an increase of deformity, but since that date I am able to report continued improvement.

Case IX.—Girl, aged six years, had a large bosse from Pott's disease of five-years' standing, and was treated by frame and jackets. The tracings from October 20, 1898, to March 20, 1899,

Tracings H.



Case VIII.—1. November 2, 1898. 2. December 21, 1898. 3. February 22, 1899. 4. August 9, 1899.

indicate a progressive increase, while one taken January 4, 1900, gives us a final gain of less than 0.5 cm. only. The tracings are so like many already presented that I have purposely omitted their reproduction.

Case X.—Boy, aged six years when treatment by this method was instituted in his case. The deformity is shown by Tracing

Tracings I.

1 2

Case X.—1. September 3, 1898, before treatment. 2. January 7, 1899. After treatment, and a final result.

No. 1, Series I. Compression myelitis and consequent paraplegia had been present for two years, and now after two years' extension treatment the paralysis is still present, with very little ameliora-

tion. The last tracing (No. 2), taken sixteen months after treatment was begun, shows only a moderate gain.

Case XI.—Boy, aged four years on admission, January 30, 1900, had a dorsal Pott's, whose deformity is shown by Tracing No. 1, Series J. There was as a complication complete paraplegia,

Tracings J.

1 2

Case XI.—February 16, 1900, before treatment. 2. November 28, 1900, after treatment.

with involvement of rectal and vesical sphincters. He had worn plaster jackets, applied in partial suspension, for nearly two years, and his paraplegia was already of six-months' standing. The improvement the day following jackets on the frame was most extraordinary, and in three-months' time he was quite restored to the

use of his limbs. The tracing taken March 28, 1900, shows most decided gain.

CASE XII.—Boy, aged four years, with dorsal Pott's and compression paraplegia, came under treatment October 28, 1899. He got no relief so far as the deformity was concerned, but the paralysis was lessened appreciably.

The result in this series of twelve cases is: Gain, five; loss, five; negative, two.

In seven cases treated by extension in bed the tracings show no change in deformity—simply remained in *statu quo ante*. This plan of treatment consisted of weight and pulley to the head, with the head of the bed raised on six-inch blocks, to get the counter-extension in weight and position of the body.

The results I present with very little comment. The tracings speak for themselves. It is only fair to state that plaster work in the hospital, as well as in the out-patient department, is done by the members of the house staff, and that in a rotating staff that keen interest in special cases is not always maintained. Methods that commend themselves to members of the attending staff are suggested to the house staff, and the details are worked out as experience goes on. One man will get the impression that one method offers advantages over another, and *vice versa*. The greatest difficulty in the management of cases months and years under observation is the tension, so to speak, of the interest displayed by those who aid us in carrying out treatment.

I must, however, in closing this communication, not fail to acknowledge the great assistance rendered me by Dr. F. Bradner, not only in carrying out details of the "frame method" during the past six months, but in tabulating these cases and in furnishing me these tracings.

THE MECHANICS OF LATERAL CURVATURE OF THE SPINE.

By ROBERT W. LOVETT, M.D.,
BOSTON.

THE present paper is a preliminary one, and reports a series of observations made on the normal movements of the spine in the cadaver and the living model, studied especially with reference to the mechanism of scoliosis. The subject is so extensive and the problems involved are so intricate that it is not possible for the writer to do more at present than to call attention to certain demonstrable facts and to certain deductions to be drawn from them.

It is a well-recognized fact that in lateral curvature of the spine, at least in cases of moderate grade, the lateral bending is associated with a twisting of the vertebræ in the long axis of the spine. To the latter phenomenon the word rotation is applied by common consent.

A large amount of literature has been accumulated in the attempt to explain the mechanism of scoliosis, especially to account for the existence of the rotation, but among the theories dealing with the subject there is no one wholly satisfactory. For the most part they are very complicated; they differ widely from each other, and no one meets with general acceptance. It is perhaps hardly worth while to enumerate them, as they may be found in such books as Hoffa and Lorenz.[1]

These theories have for the most part been formulated either from purely theoretical considerations or by reasoning back from the pathological changes found in more or less advanced cases. As neither of these methods has so far yielded satisfactory results,

[1] Hoffa. Lehrbuch der orth. Chir., 1898, p. 370; Lorenz: Path. und Ther. der Seitl. Ruckgratverkrummungen, 1886, p. 17.

it may be advisable to turn to the study of the normal movements of the spine to see if in them is to be found any explanation of the phenomena observed in scoliosis.

Bradford's Experiment. One previous attempt has been made and published in this line of investigation by Bradford, who demonstrated that in the cadaver a rotary lateral curvature of the type seen in life might be produced by superincumbent weight coming obliquely upon the spinal column. This important experiment demonstrated that in the normal spine of the cadaver exist conditions capable of producing the phenomena found in scoliosis when superincumbent weight falls obliquely upon the column.[1] Some similar work on the cadaver was done by Dr. E. G. Brackett, but was never published.

The experiments described in the present paper were made by the writer during the past six months, in part at the Harvard Medical School by the courtesy of Prof. Thomas Dwight, to whose supervision and suggestions he is greatly indebted. The work was undertaken with a hope of contributing something to the present knowledge of the normal movements of the spine without special reference to scoliosis, but early in the investigation certain phenomena bearing so closely on the causation of scoliosis were observed that the rest of the investigation was deferred and the time devoted wholly to the question of the causation of rotary lateral curvature. It is the hope of the writer to pursue the rest of the investigation at some future time.

Movements of the Spine. The movements of the spine are generally accepted as being four in number:[2]

1. Flexion (forward bending).
2. Extension (backward bending).
3. Lateral bending (side bending).
4. Torsion.

Although this classification is usually found in the books it has been often recognized that torsion is in some way associated with lateral bending. That lateral flexion probably does not exist as a pure movement has for some time been recognized by some if not

[1] Bradford and Lovett. Orthopedic Surgery, second edition, 1899, p. 94.

[2] Poirier et Prenant. Traité d'Anat. Hum., i. 744; Gray's Anatomy; Landerer: Mechanotherapie, 1894, p. 217, etc.

all anatomists, and has been taught for some years by Professor Dwight. As long ago as 1844 Henry J. Bigelow[1] wrote: "The principle of torsion is illustrated by bending a flat blade of grass or a flat, flexible stick in the direction of its width. The centre immediately rotates upon its longitudinal axis to bend flatwise in the direction of its thickness. In the same way the spine, laterally flexed, turns upon its vertical axis to yield in its shortest or antero-posterior diameter." Occasional references are found to the association of torsion with lateral flexion,[2] but no definite recognition of the relation between the two seems to exist.

It is the purpose of this paper to show that lateral flexion and torsion of the spine are associated parts of one compound movement and that neither can exist without the other. That, however, in side bending from the flexed position the torsion is diametrically opposite from what it is in the extended position and that the spine follows the laws governing flexible rods in this regard.

1. *Flexion* apparently exists as a pure forward movement and its amount varies greatly with the flexibility of the individual.

2. *Extension* apparently exists as a pure backward movement and its amount varies greatly with the flexibility of the individual.

3. *Lateral flexion* of the spine apparently does not exist as a pure movement. Something very like a pure lateral flexion is found experimentally in one position of the trunk, but owing to the complex conditions existing it is not possible to measure it with sufficient accuracy to say how pure the movement is or with how much torsion it is associated. In general, lateral flexion in any position of the trunk is associated with torsion.

The cadavers used in these experiments were six in number, and had previously been used in the dissecting-room. The sternum and contents of the chest and abdomen, as well as the arms and scapulæ, had been removed, also the abdominal and most of the back muscles.

Experiment, cadaver: *Flexion.* If the pelvis of a normal cadaver is fixed in a vise and the upright spine flexed, and by a

[1] Orthopedic Surgery. Boylston Prize Essay for 1844, Boston, 1845, p. 168.

[2] Hoffa. Lehrbuch der orth. Chir., 1898, p. 372; Henke: Handbuch der Anat. und Mech. der Gelenke, p. 66; v. Meyer: Virch. Arch., xxxv., p. 225; Tubby: Orthopedic Surgery, London, 1896, p. 143; W. A. Lane: Guy's Hospital Reports, xxix., p. 293.

cord attached to the atlas pulled to the left side, a very marked torsion occurs through the whole column, and each vertebra appears to change its relation to the one below it, not only in the lateral movement that it makes, but by torsion around the long axis of the spine. And this torsion always occurs in one direction in flexion, the bodies of the vertebræ turning toward the convexity of the curve and the spinous process toward the concavity. Each vertebra twists upon the one below it in the long axis of the spine,

FIG. 1.

Spine fixed in vise, flexed and bent to the left. The boards mark the plane of the pelvis and chest. The hat pins are driven into the spinous processes. The torsion of the spine is shown by both boards and pins, the bodies turning to the right.

the body turning in one direction and the spinous process in the other. In the cadavers experimented upon the torsion of the cervical vertebræ upon the last lumbar in side bending amounted to perhaps forty-five degrees in flexion. This torsion is slight in the lumbar region and marked in the dorsal region, especially between the fourth and twelfth dorsal vertebræ.

In the photograph (Fig. 1) thin boards are shown fastened to the chest and pelvis to mark the lateral plane of each, and hat pins

were driven into the spinous processes of the first sacral, one of the lower dorsal, one of the upper dorsal, and one of the lower cervical vertebræ, to mark the antero-posterior axis of each vertebræ. By having both of these modes of measurement at the same time, it may be shown that the variation of the boards corresponds to the torsion of the vertebræ—as represented by the pins driven into them.

FIG. 2.

Model with spine flexed and bent to the left. The boards show the planes of chest and pelvis. The board marking the chest has rotated backward on the convex side of the curve.

Model: Flexion. The same experiment was then made upon two models. Both were young women, professional models and markedly flexible ; one had been upon the stage as a dancer, and the other kept herself flexible by exercise to enable her to take difficult poses without lameness. If the model bends forward and flexes her spine to the left the same phenomenon occurs that is

seen in the cadaver. The spinous processes turn to the concavity of the curve ; that is, to the left, which means that the vertebral bodies turn to the convexity and the right side of the chest becomes more prominent behind—that is, the rotation is backward on the convex side of the curve, as in the rotation of scoliosis. In the

FIG. 3.

Model flexed and bent to the left. The cardboard indicators have turned to the left

experiments the models were ignorant of the purpose of the experiment and were told to bend to the left without twisting.

Fig. 2 shows Model 1 with boards fastened to pelvis and chest in a similar position to that of the cadaver in Fig. 1. Fig. 3 shows Model 2 in the same position as that of the cadaver in Fig.

1, with cardboard indicators fastened over the spinous processes by sticking plaster. The rotation backward of the chest on the convexity of the curve may be seen in both Figs. 2 and 3.

In reply to a possible criticism of the experiment, that the scapulæ, ribs, and muscles cause an apparent rotation of the boards and indicators in the living model which does not exist, it may be said that the direction of the boards and indicators has been shown to correspond to each other in the cadaver, and each one of these

FIG. 4.

Spine flexed in vise, hyperextended and bent to the left. The boards mark the plane of the pelvis and chest. The pins are driven into the spinous processes. The pins have turned to the right, showing that the vertebral bodies have twisted to the left—that is, toward the concavity of the lateral curve.

taken separately behaves in the model as it does in the cadaver. Moreover, the rotation of the spinous processes of the vertebræ in the live model can be easily appreciated by the fingers, showing that it is a real torsion and not an apparent one.

Lateral bending, then, in both cadaver and model in positions of marked flexion is accompanied by torsion, and this torsion is in this position always in one direction, and is of the same type as the rotation seen in scoliosis—that is, backward on the convexity of the curve, or, in other language, the bodies of the vertebræ

turn toward the convexity of the lateral curve. Various attempts were made to reverse this torsion while making side bendings in the flexed position by pulling the vertebræ apart, pressing them

Fig. 5.

Model with spine extended bending to the left. The board marking the plane of the chest has rotated backward on the left side.

together, etc., but in all cases in both cadaver and model the type of torsion described above persisted.

Cadaver: Extension. If the spine of a cadaver is fixed in an upright position in a vise which clamps the sacrum, and if this spine is hyperextended (bent backward) and pulled to the left in this extended position by a cord attached to the atlas, a torsion

FIG. 6.

Model with spine extended bending to the left. The cardboard indicators show that the spinous processes have turned to the right and the bodies to the left.

takes place, but this torsion is exactly the reverse of the one occurring in the similar pull to the left made in the flexed position. The spinous processes rotate toward the concavity of the curve and

the type of the rotation is the reverse of that usually seen in scoliosis in life (Fig. 4). This torsion occurs less in the lower dorsal and lumbar region than does the one described in speaking of flexion, and is located higher in the column. The method of observation was by boards and pins, as in the flexion experiment.

Model: Extension. If, now, a model is asked to extend her spine and then to bend to the left, it is noticed that the board marking the lateral plane of the chest turns backward on the side of the concavity of the curve, which is the reverse of the condition found in side bending in flexed positions—that is, in the model the rotation of the vertebral bodies must be toward the side of the concavity. This type of torsion is constant in all side bendings in the extended positions as observed in models and in patients.

Fig. 5 shows Model 1 bending to the left with backward rotation of the chest on the left side.

Fig. 6 shows Model 2 bending to the left in an extended position, with cardboard indicators fastened to the skin over the sacrum, the upper lumbar, the middle dorsal, and the lower cervical region. It will be seen that the indicators show a marked rotation of the spinous processes in the dorsal region toward the convexity of the curve, and the bodies must rotate toward the concavity. Compared with Fig. 4, it will be seen that the indicators point in the same direction as in the cadaver placed in the same position, and compared with Fig. 3, a photograph of the same model bending to the left in the flexed position, it will be seen that the indicators point in the opposite direction.

In the intact spine of the cadaver, therefore, and in the model, side bending in the extended position is accompanied by torsion of the vertebral bodies toward the concavity of the curve ; in other words, the rotation is backward on the concavity of the curve, which is the reverse of the condition ordinarily seen in life in scoliosis.

Experiment, Cadaver: Flexion and Extension. As the complicated movements of the spine in these experiments introduced an element of mixed planes most confusing to the observer, the following experiment was undertaken by Professor Dwight and the writer at the suggestion of the former, in order to obtain a graphic record of the torsion : A spine was placed upright in a

vise at the edge of a table three feet from the floor; a hole was bored through the eleventh dorsal vertebra from behind forward —that is, in the median plane of the body. Through this hole was passed a brass rod five feet in length, which projected three feet behind the spine and a short distance in front of it. This rod, of course, represented the antero-posterior axis of the vertebræ. By means of a plumb-line, dropped from the rod, the direction in which this rod pointed could be projected upon the

FIG. 7.

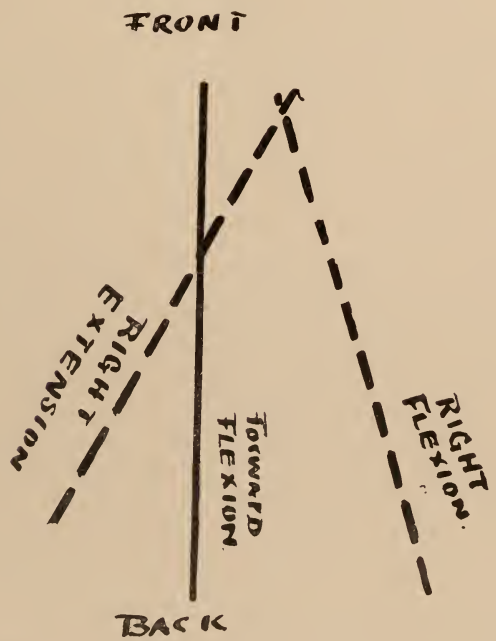


Diagram of position of brass rod in right flexion and extension of spine of cadaver.

floor and its variations in the horizontal plane recorded graphically. This eliminated any element of confusion on the part of the observer by giving a permanent and accurate record. The spine was then flexed, and before being bent to either side, the direction of the indicator was projected. The spine was then bent sideways to the right and to the left in the flexed position and the direction of the indicator recorded in those positions. It was then extended and bent to the right and left in the extended position

and a diagram was obtained (Fig. 7). The crossing of the two lines to the right of the median plane, one for right flexion and one for right extension, shows plainly enough that there exists one type of torsion for side bending in flexion and another for bending to the same side in extension.

Pure Lateral Flexion. If one type of torsion changes to the other type in going from flexion to extension, there must be a position between marked flexion and marked extension where the planes cross, and in this position, if anywhere, the purest lateral flexion must exist. By experiment in both cadaver and model this plane was found to be in slight flexion of the spine in the upright position, perhaps fifteen degrees in front of the perpendicular. In the sitting position in the model, this plane exists in a slightly more extended position than when standing upright. In the upright position of the soldier, side bending is accompanied by the extension type of torsion.

Reasons for Torsion. It is obvious from these experiments that there must be some fundamental reason for the constant occurrence of one type of torsion for side bendings in flexion and the occurrence of another type in extension, as well as for the constant association of torsion with side bending. The vertebral column is a flexible rod capable of bearing great weight. It is not equally flexible in all directions, but it is, of course, capable of some movement in all planes, and as such should come under the control of the laws governing flexible rods in general. The extent of any of the movements of the spine are, of course, greatly influenced by the shape of the vertebral bodies, the curves of the spine, the character of the articular processes, the resistance of the ligaments and the relative strength of the muscles. But in spite of these complicating elements, it seemed worth while to investigate the behavior of flexible rods in general under similar conditions. Professor Dwight suggested that this line of investigation might be of use.

To Professor Hollis, of Harvard University, the writer is indebted for much information on the mechanical side of the question.

From the mechanical point of view, torsion results from any motion in which all the particles of a straight flexible rod do not move in parallel planes. Consequently, if such a rod is bent in

two planes at the same time torsion must inevitably occur. The vertebral column is not a straight flexible rod, but one bent in the antero-posterior plane by a series of gentle curves; side bending must therefore inevitably lead to torsion, because it means bending in two planes. Nor does the fact that the intervertebral disks permit motion in all directions affect the question, because from a mechanical point of view the vertebral column behaves in general as it would if it were a homogeneous flexible rod, and one does not have to wait for torsion to occur until the intervertebral disks are compressed and the edges of the vertebræ come into contact, for, from a mechanical point of view, the torsion begins with the beginning of the side bending. It, therefore, seems very unlikely that pure lateral flexion of the spine as a whole ever exists.

A strip of sponge rubber, half an inch in diameter and fourteen inches long, rotates in the same way that the vertebral column does in the same position. It rotates in one direction for side bending when bent forward and in the opposite direction for side bending when bent backward, and the rotation follows the same rule observed in the vertebral column in the cadaver and in life. A lateral curvature, in what corresponds to the flexed position of the spine, may be produced in the rubber strip following the same rule of rotation seen in life—that is, the front of the rod turns toward the convexity of the lateral curve. An artificial lateral curvature in the rubber strip, made in what corresponds to the extended position of the spine, results in a reverse rotation to that from the rotation of the flexed position. A piece of rattan, a gum-elastic catheter, a piece of rubber tubing, or a strip of sponge rubber, round or square, behave all in the same way, and rotate in the same direction as does the spine when placed in a similar position to those described in the experiments on the model and cadaver, except that they allow pure side bending in the lateral plane.

For side bendings, when bent forward, the flexible rod rotates one way, and when bent back and to the same side it rotates the other way. So far as this analogy goes, the spine, therefore, in its rotations does no more than to follow certain laws governing flexible rods, and the elaborate theories to account for the occurrence of rotation in scoliosis may be replaced by the statement that the

spine behaves in general as any flexible rod would under similar conditions so far as rotation is concerned.

Articular Processes. Although it is easy to understand that the column of vertebral bodies by itself might easily behave as a flexible rod, yet the articular processes cannot be left out of account. They must be an important factor in determining torsion, and they must do one of two things. Either they must fall in with the behavior of the flexible column of bodies and serve to carry out the rotation which would occur without them, or they must obstruct or reverse the rotation which would occur in the column of vertebral bodies alone.

Experiments, Cadaver: Spine without Vertebral Bodies. The experiments to be given seem to show that when the articular processes are in contact they merely serve to accentuate the same rotation that would be present if the column of vertebral bodies were by itself.

Two vertebral columns, which had been previously used and which had conformed to the usual rule, were prepared for experiment by removing the column of bodies by cutting through the pedicles. The columns experimented upon then consisted of laminæ and articular processes with their ligaments. The ribs were not removed from these columns. These columns could no longer be regarded as flexible rods, and were only anatomical preparations to demonstrate just what part in rotation the articular processes would play if left to themselves.

Each of these spines were then placed in a vise as in the experiments described above and pulled to the side in the same way. When the spine was extended and pulled to the left rotation occurred of the same type as in the intact column in the similar position, a rotation of the ribs backward on the side of the concavity —that is, the articular processes alone do the same thing in side bending in the extended position that the intact column does (Fig. 8).

In side bending from flexed position, however (Fig. 9), the spine without bodies rotates in just the reverse direction from that of the intact spine in the same position, the rotation of the ribs being backward on the side of the concavity. This, of course, suggests that in side bending in the extended position the articular processes are active, but that in flexed positions they are not.

To see if this state of affairs really existed, a spine which had been used and which had followed the rule was sawed longitudi-

FIG. 8.

Spine without vertebral bodies extended and bent to the left. The rod marking the plane of the chest has rotated backward on the left. (Compare Fig. 4.)

nally in such a way as to divide each articular process in the long axis of the spine. The portion on the outer side of this cleft was

FIG. 9.

Spine without bodies flexed and bent to the left. The rod marking the plane of the chest has rotated backward and to the left. (Compare Fig. 1.)

removed, giving a view of each articulation. The spine was then flexed, and it was found that as moderate flexion began the articu-

lar joint surfaces in the dorsal region, which was the particular field observed, began to separate, and in extreme flexion were separated by an interval of perhaps one thirty-second of an inch. As the spine was extended they seemed to come into close contact at about the point where the flexion rotation changes to the extension rotation. In marked extension they were firmly in contact.

FIG. 10.

Model twisting to the left, showing the consequent lateral deviation of the spine.

The conclusion from this is that the column of vertebral bodies alone, without articular processes, would rotate in just the same way in side bending in flexion and extension that the column does with articular processes present. That in flexion they are not sufficiently in contact to determine the rotation, but that in exten-

sion they are in contact, and are the active factors in determining the rotation which occurs in extension. That rotation is, however, in the same direction that it would be if the column consisted of vertebral bodies alone. They apparently serve to accentuate and carry out the behavior of a flexible rod in general, although they undoubtedly aid in preventing pure lateral flexion of the spine.

Leaving for a moment out of consideration the behavior of the column without vertebral bodies, and confining ourselves to the intact column in the cadaver and the model, it is shown by the experiments that there is one torsion for side bending in flexion and a diametrically opposite one for side bending in extension, and that the type of torsion seen in scoliosis in life is the one occurring in side bendings in flexions where, in orthopedic terms, the rotation is backward on the side of the convexity of the curve.

4. *Rotation.* The fourth motion of the spine mentioned at the beginning of the paper must now receive attention. If lateral flexion is associated always with rotation, if the two are component parts of one composite movement, one would expect as a corollary to what has gone before that rotation could not exist without causing lateral flexion.

An experiment was made on the cadaver, which was fixed as described above and the atlas sharply rotated to one side. A well-marked lateral deviation of the spine took place.

Model No. 1, seated on a stool, was told to twist to one side, but not to bend laterally in so doing. Fig. 10 shows that a well-marked lateral deviation of the spine occurred in this experiment. A similar photograph was taken of Model 2, showing exactly the same condition. It therefore seems as if torsion of the trunk could not occur without lateral deviation.

Accepting the fact that in the spine lateral flexion cannot exist without torsion, it is plain why rotation should accompany any degree of lateral deviation of the spine ; they are two parts of one movement, and neither can exist alone.

Causes of Lateral Deviation of the Spine in Life. To account for the phenomena found in rotary lateral curvature one has then only to formulate the factors which will cause the spine to be held to one side of the perpendicular ; compensatory lateral deviation must occur, and with it rotation. Such causes are manifold and well

recognized, for asymmetry is the rule rather than the exception. Neither the head nor the pelvis can vary from their normal relation without producing some degree of compensatory lateral deviation somewhere in the spine.

Asymmetry of the head is a factor not often taken into account. Asymmetrical position of the head is favored by the fact that in most cases the condyles of the occiput are not in their best contact with the superior articular surfaces on the atlas when the head is held straight ; a closer and better contact is generally obtained by a slight twisting of the head. This fact was pointed out to the writer by Professor Dwight. Ocular defects causing improper balance of the head are an obvious cause. One has only to observe the faulty carriage of the head in many cases of scoliosis to see that here is a condition of importance and often too marked a condition to be accounted a result of the scoliosis. Asymmetry of the pelvis as described by Barwell must be accounted as a not infrequent cause of asymmetrical positions. Asymmetry of the spine itself and unequal thickness of the vertebral bodies on the right side as contrasted with the left must be remembered as a demonstrated condition.[1] Shortening of one leg is so common that it fails to attract the attention that it deserves.[2]

All these defects of conformation must lead to some lateral deviation of the spine. It depends upon the individual whether these are taken care of by nature in some compensatory way, or whether they cause a deviation notable enough to be classed as a deformity.

Aside from the structural defects causing asymmetry and consequent lateral deviation, are to be found the vicious postures resulting from attitude and occupation, which must be accounted another important factor in producing scoliosis.

Type of Rotation in Scoliosis. In flexion it may be repeated that side bending of any part of the spine must be accompanied by rotation of the vertebral bodies toward the convexity of the curve. Inasmuch as the great majority of cases of scoliosis show this type

[1] Herth. Zeitsch. f. orth. Chir., 1892, i., p. 246; Schulthess: Zeitsch. f. orth. Chir., 1899, vi., p. 1.

[2] Hunt. The American Journal of the Medical Sciences, January, 1879; Philadelphia Medical Times, August 3, 1878; T. Dwight: Journal of Anatomy and Physiology, 1879, xiii., p. 502; Morton: Philadelphia Medical Times, July 10, 1886; Bradford and Lovett: Orthopedic Surgery, 1899, second edition, p. 595.

of rotation, it is evident that such scoliosis must have had its beginning during flexed positions of the spine. It is a well-known fact that many cases of scoliosis are preceded by round shoulders, and the muscular development of patients with scoliosis is as a rule

FIG. 11.

Model sitting on an inclined seat. The cardboard indicators show that the bodies of the vertebræ have rotated to the left—that is, toward the convexity of the lateral curve.

below the average. Poor muscular development of course predisposes to a flexed position of the trunk.

It seems likely that the beginning of scoliosis is much more often acquired by children in the sitting than in the standing posi-

tion, because the sitting position makes flexion of the spine more easy than does the standing position.

An experimental scoliosis with rotation is shown in Fig. 11, in which Model 2 was asked to sit squarely, but at ease, on an inclined seat. The indicators on the skin over the spinous processes show that the bodies of the vertebræ have rotated toward the convexity of the lateral curve.

Reverse Rotation. The "reverse rotation," where the rotation of the vertebral bodies is backward on the side of the concavity of the curve, has been described as occurring in life, and has been somewhat discussed.[1] Although the writer is not yet prepared to accept the fact that this apparent type of rotation is anything more than a slight lateral deviation with excessive rotation, yet the experiments above related show how the so-called "reverse curve" in scoliosis might occur from an anatomical point of view. If a column is curved laterally in the extended position this type of rotation must be found. One has only to examine a dried vertebral column to see that lateral motion between the dorsal vertebræ when their articular processes are in contact must result in the rotation of the bodies toward the concavity of the lateral curve. Moreover, such a type of rotation is an intrinsic property of any flexible column bent to the side in the extended position.

School Furniture. In the prophylaxis of scoliosis, from this point of view, correct school furniture seems to be of the greatest importance. Sitting to one side in the flexed position is to be avoided on anatomical grounds, and it is interesting to note that the weight of opinion has inclined to the style of chair and desk in which the edge of the desk overhangs the edge of the chair, the so-called "minus distance." It is easy to see that an arrangement of school furniture which allows a growing child to sit for hours with a flexed position of the spine, with muscles tired and stretched, is one which predisposes to a deformity which is associated with the flexed position. Inasmuch as we have seen that torsion causes of itself lateral deviation of the spine, the twisted position that children assume in writing, especially in connection with flexion,

[1] Jach. Zeitsch. f. orth. Chir., 1892, i. p. 252; Steiner and Schulthess: Zeitsch. f. orth. Chir., 1896, v.; Kirmisson and Sainton: Revue d'Orthopédie, 1895, iii.; Vulpius: Zeitsch. f. orth. Chir., 1896, iv., p. 63.

must of itself be accounted a direct cause of scoliosis, inasmuch as it causes lateral deviation of the spine. It has been demonstrated[1] that children who sit squarely at their writing, and who learn the upright style of writing, show a smaller percentage of scoliosis than children who learn the slanting hand, a fact easily explained from this point of view.

Treatment. Of course, theoretical conditions such as those given above are of value only in so far as they may influence prophylaxis and treatment. Scoliosis on this supposition may be assumed to be a deformity arising from superincumbent weight coming obliquely upon the spinal column in the flexed position. The correction, so far as possible, of asymmetrical attitudes and the prevention of undue flexion of the spine would seem to constitute the prophylaxis.

In the treatment of the condition when it exists, on this supposition, much emphasis must be laid on the detection and correction where practicable of the causes of asymmetrical attitudes. It is not always possible to do this. A short leg can be compensated for by a thicker sole, but an asymmetrical pelvis cannot be rectified.

The second and more important deduction to be made from the experiments is the importance of securing and maintaining the spine in a position of extension at the seat of deformity. If the rotation of the extended position is the reverse of that of the flexed position, the use of extension as a means of treatment deserves a much more important place than it has received.

It is easy to see from this point of view why symmetrical gymnastics, cultivating the extensor muscles, such as those described by Teschner,[2] are of so much value; and it also explains what many of us have found out empirically, that it is desirable to hold and exercise the spine in positions of extension.

The problem seems to be, from an anatomical point of view, to bring the articular processes into firm contact, and to get their influence in counteracting the rotation acquired during flexion, as well as to call upon the intrinsic property of the spine as a flexible rod to reverse in extended positions the rotation acquired in the flexed positions. In a case of dorsal lateral curvature it is not

[1] Burchard. Zeitsch. f. orth. Chir., 1892, ii., p. 1; Kotelmann: School Hygiene, p. 315.
[2] Teschner. Transactions American Orthopedic Association, vol. ix., p. 10.

enough to give backward flexions which shall take place chiefly in the lumbar region; such backward flexions must be made so far as possible to take effect in the region where the lateral deviation exists. It is the extended position of the deviated region that one wishes to bring about.

Given a fairly movable spine with a primary curve to the right in the dorsal region, and a rotation backward on the right side of the curve, the correction of such a rotation must be most easily made by exercises given to induce extension of the dorsal part of the spine where the deviation exists. By calling upon the intrinsic property of the spine to reverse in extended positions the rotation acquired in flexed positions, it would seem that we are pursuing the most rational course. It would seem also that forcible correction should also be made in the position of extension of the spine and that a forward thrust at the seat of the lateral deviation should diminish the rotation.

When, however, it comes to the question of fixed curves and deformed vertebræ, the question is one of such complexity and difficulty that it is impossible from these experiments to speak at present as definitely as one can in cases more nearly normal.

The use of symmetrical extension exercises and of side bendings in the extended position is, therefore, from an anatomical point of view, most important.

Gymnastics. It must be evident from what has been said that simple gymnastic exercises are safer than complicated ones. Many persons prescribe exercises of such complexity and intricacy that no one can possibly judge just what he is doing. If side bendings inevitably cause torsion and torsion lateral deviation, they are dangerous gymnastic elements to introduce into a problem already difficult enough. Safety lies in prescribing only exercises of which one can estimate the anatomical effect.

The writer is fully aware that this paper leaves out of consideration the subdivision of lateral curvature into the varieties according to their etiological types as well as the various types of curves. Given, as we have in the spine, the mechanism ready to produce a scoliosis and a superincumbent weight coming obliquely upon the column from some of the causes mentioned above, the column will yield where it is weakest; it may be in the lumbar region or in

the dorsal. Compensatory curves will occur, bony deformity will result if the condition continues, and the complicated structure of the parts involved will allow of almost infinite variety in the location and the character of the curve. The ribs, of course, follow the rotation of the vertebræ to which they are attached. The writer has endeavored to deal only with the broader aspects of the question and to avoid generalizations from clinical experience.

SUMMARY. This paper may be summed up in a few words as follows :

Torsion and side flexion of the spine are parts of one compound movement, and neither exists to any extent alone. Lateral deviation of any part of the spinal column is therefore necessarily associated with torsion (rotation) at the seat of the deviation.

In flexed positions bending is associated with torsion in one direction, in extended positions by torsion in the opposite direction. In this it follows simply the mechanical law governing flexible rods, which rotate in general in the same way in corresponding positions. From the kind of torsion observed in scoliosis it is obvious that the deformity originates in the flexed position of the spine. The correction of the rotation would, therefore, seem to be logically made by throwing the spine into extended positions and in taking side bendings from extended positions.

Sitting in the flexed position by school-children is likely to be harmful, and sitting in a twisted position of necessity induces lateral deviation temporarily. The immediate cause of lateral deviation is, as a rule, to be found in some asymmetry of development or posture which leads to an oblique direction of superincumbent weight, causing the spine to deviate from the middle line.

THE RELATION OF DEFORMITY OF THE PELVIS TO LATERAL CURVATURE OF THE SPINE.

By H. P. H. GALLOWAY, M.D.,
TORONTO, CANADA.

Of the various theories which have been advanced regarding the causation of lateral curvature of the spine, that which attributes to the superincumbent weight the chief etiological importance is the one most generally accepted, and rightly so. It is probable, however, that the superincumbent weight can produce lateral curvature and rotation only when the spine has already deviated from the vertical position so that the downward pressure bears obliquely upon some portion of the spinal column. This has been shown experimentally by Bradford and Lovett, and is in harmony with what one would expect from theoretical considerations. This primary want of erectness of the vertebral column may grow out of various conditions. Unbalanced muscular development, a slight paralysis of one lower extremity, a painful or weak foot, or a difference in the length of the legs may lead unconsciously to the assumption of a faulty attitude because of its being the position of greatest ease or of least effort. Given a faulty attitude habitually assumed, especially in a growing child of weak muscular development and imperfectly ossified bones, and the conditions are ripe for the superincumbent weight to become a slowly acting but irresistible mechanical force in producing lateral deviation and rotation, at first slight in amount and easily corrected, but finally altering the shape of the vertebræ and putting upon the deformity the stamp of permanence.

While accepting this explanation of the mechanics of many cases of lateral curvature, my observations have convinced me that the

primary mechanical fault in certain cases is one which has received scant attention in orthopedic literature.

Several standard works on orthopedic surgery refer to deformity of the pelvis in connection with the subject of lateral curvature, but the pelvic distortion appears to be regarded as an effect rather than a cause of the spinal deformity. Thus in the last edition of Bradford and Lovett's work (*Orthopedic Surgery*, Bradford and Lovett 1899) we read, "In severe cases all the bones of the trunk may be altered and also the pelvis" (page 104); and in another place, "The pelvis is not necessarily distorted in lateral curvature of the spine, but the bones of the pelvis may, if not sufficiently

FIG. 1.

unyielding in their structure, become altered by abnormal pressure or strain" (page 110). Tubby says (*Deformities: a Treatise on Orthopedic Surgery*, by A. H. Tubby, 1896), page 140: "The pelvis in severe cases is much deformed. In the ordinary deformity to the right in the dorsal, and to the left in the lumbar region, the shape of the pelvic cavity is abnormal, the lumbosacral angle pointing to the left and encroaching to a marked degree on the left half of the cavity. . . . The wings of the sacrum and ilium on the left side are thickened and the crest of the ilium is lower." An illustration, here reproduced, accompanies the description (Fig. 1). It seems clear that these writers regard the pelvic dis-

tortion as secondary to and consequent upon the spinal deformity, but it appears to me that the cause is mistaken for the effect.

Aside from *post-mortem* proof, it must be evident to every one who carefully examines many cases of lateral curvature that the pelvis often is not symmetrical. It will be observed quite frequently that one posterior iliac spine or one iliac crest occupies a lower plane than its fellow. In some cases measurement plainly shows this to be due to a difference in the length of the legs, but in not a few instances the most careful measurements can detect no such disparity. The plain inference is that there is some asymmetry of

FIG. 2.

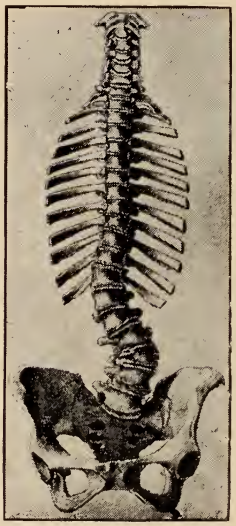


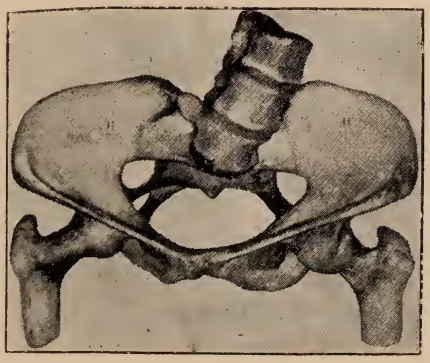
FIG. 3.

the pelvis itself—that its two lateral halves are of unequal size or different in shape. If one lateral half of the pelvis is smaller than the other, or if the pelvis as a whole is distorted, so that the posterior iliac spine or the iliac crest of one side is lower than that of the other, it is fair to assume that the sacrum which is grasped between the two ilia is somewhat tilted laterally, and that consequently its base is on a lower plane at one side than at the other. As the base of the sacrum is the foundation upon which the vertebral column is erected, if this be slanting the column resting upon it will also lean to one side. Being a flexible instead of a

rigid column, however, and having attached to it muscles which can move it in various directions, the individual to whom the column belongs instinctively endeavors to bring it to a more erect position so as to restore his equilibrium. And because the column is made up of various segments more or less freely movable upon one another, this effort to straighten it produces, not a sharp bend, but a curvature in the lumbar region, and this necessarily leads to one or more secondary or compensatory curvatures higher up. And because the anatomical structure of the spine makes any great amount of lateral bending impossible without accompanying torsion, rotation is produced as well as curvature.

Figs. 4, 5, and 6 are from a paper by Dr. James Clifton Edgar, which appeared in the *New York Medical Journal* on

FIG. 4.



December 5, 1896, and are intended to show various types of deformed pelves, which may give rise to dystocia during labor. These figures, used for the purpose of illustrating an entirely different subject, also show clearly that a tilted sacral base, with the portion of the spinal column immediately above it leaning to the same side, is by no means merely a matter of theory or imagination.

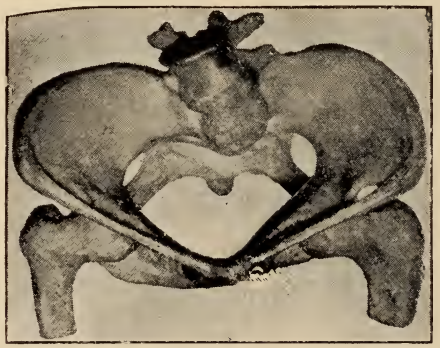
This slanting sacral base is also well shown in Figs. 1, 2 and 3, reproduced from Tubby's book, illustrating specimens in Guy's Hospital Museum.

A spinal column resting upon such an inclined sacral base as that shown in several of these figures must necessarily start upward

leaning to one side, and curvature and rotation are inevitable as a result of the individual's efforts to restore his equilibrium. The portion of the trunk above the pelvis is not placed squarely over the latter, and the curvature results from the patient's effort to restore the proper balance of the body. Just here it may be pointed out that the prominence of one hip in the case of an individual with a deformed pelvis is not necessarily entirely due to the altered relation of the pelvis to the portion of the trunk above it, but is also to some extent directly dependent upon the pelvic deformity.

That deformity of the pelvis is often associated with lateral curvature is not disputed. The point under discussion is which is the primary and which is the secondary, which is cause and which

FIG. 5.



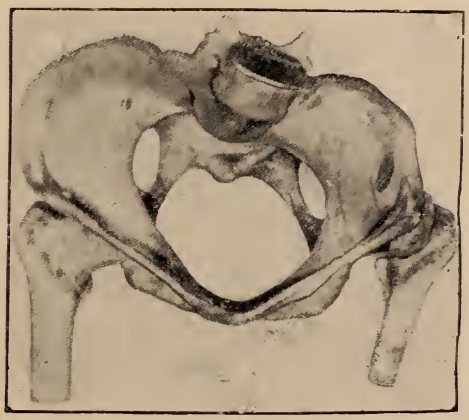
effect? To my mind it is much more reasonable to look for the primary fault in the foundation than in the superstructure.

The pelvis is practically a solid bony basin, the component parts of which admit of little or no motion between them. In standing it is poised upon the powerful lower extremities by which it is brought into intimate relation with the supporting surface of the earth, while in all ordinary sitting postures it is more or less perfectly balanced upon the tuberosities of the ischia. On the other hand, the vertebral column, above the sacrum, is composed of segments freely movable upon one another and separated in front by yielding cushions. Resting upon the free upper end of this swaying column, where the leverage is greatest, is the large, heavy,

overhanging head. In short, the conditions are such that the column can be held erect only by continuous muscular effort, and the moment the muscles relax sufficiently to allow some portion of the spine to deviate to one or the other side, the superincumbent weight becomes a possible deforming mechanical force, of equal efficiency whether the individual be sitting or standing.

It is unreasonable to suppose that a solid and relatively fixed foundation like the pelvis should fall prey to any distorting influence that could be exerted by such an unstable, jointed superstructure as the spine; while on the other hand the inherent adjustability of such a superstructure must cause it to accommodate

FIG. 6.



itself to a tilted foundation. This can be at once demonstrated by raising one side of the pelvis by putting an elevation of an inch or two under one foot. By this simple experiment we artificially raise one side of the sacral base, with the result that the spinal column instantly accommodates itself to the tilted foundation, exhibiting a lateral curvature.

The question may arise: If the pelvis be so circumstanced that it does not yield readily to the influences which give rise to deformity in the spine, as is here contended, how does it become deformed so as to be the starting-point of the curvature? Although the answer to this question does not come properly within the scope of this paper, the object of which is simply to inquire what is the

true relation of lateral curvature to the pelvic deformity which it is admitted is frequently associated with it, a word may be added.

It is universally accepted that the severer forms of pelvic distortion in the vast majority of cases are traceable to rickets, and when it is considered how frequently various other evidences, sometimes slight but none the less unmistakable, of the effects of this disease upon the skeleton are met with, it is not unreasonable to suppose that the pelvis, which is so situated that only palpable deformity is likely to attract attention, suffers from some degree of asymmetry more often than is generally supposed. At any rate, many experienced obstetricians believe that slight but unrecognized degrees of pelvic deformity are responsible for numerous cases of difficult parturition. This belief, together with the fact that lateral curvature occurs much more frequently in females than in males, deserves consideration in connection with the writer's contention that pelvic deformity may stand in a causative relation to lateral curvature.

As further possible causes of pelvic deformity, it is scarcely necessary to mention osteomalacia and dislocation of the hip, or refer to the fact that there is no evidence to show that slight unilateral asymmetry of uncertain origin is less apt to occur in the pelvis than in other portions of the body.

Another matter calls for a word of consideration in connection with the subject of this paper. Most cases of lateral curvature present deformity in both dorsal and lumbar regions, but it has always been a disputed point which should be regarded as the primary and which the secondary curvature. If it be admitted that pelvic deformity is the initial mechanical fault in certain cases, then in this class at least the lumbar curve is primary.

SPASMODIC LATERAL CURVATURE OF THE SPINE.

By ARTHUR J. GILLETTE, M.D.,
ST. PAUL.

Possibly the term hysterical rather than spasmodic would be more applicable, as there certainly existed in two of the cases reported a decidedly nervous condition. The first case was seen a number of years ago in a boy seven years of age—and the fact of its being hysterical did not suggest itself.

It was observed that there was a decided spasm of the muscles of the one side of the back, sufficient to cause a lateral curvature of the spine and a tilting of the pelvis. The spasm was completely overcome, though temporarily, by either the use of Sayre's suspension apparatus, by manipulations, or by a strong faradic current applied to the back.

A positive diagnosis was never made in this case, although a beginning Pott's disease was thought probable, as there seemed to be some disturbance of sleep at night. There were no other symptoms either in the family history, the history of the disease, or the appearance of the child. Later it was diagnosed by an orthopedic surgeon as Pott's disease, and still later by an orthopedic surgeon as hysterical lateral curvature of the spine. The writer has never seen the case since and has no opinion to offer, but it so resembled the two cases which were more fully followed out that I am inclined to think it hysterical, even though it did occur in a boy and he so young.

The second case was that of a girl six years of age—of Jewish parentage. There was a slight deviation of the spine in the lower dorsal and lumbar regions to the left; there was a spasm or rather, I should say, rigidity of the muscles of the right arm and forearm, resembling at first sight the spasmodic condition of cerebral palsy.

Examination by a neurologist proved it not to belong to any form of spastic or infantile paralysis; nor did the history indicate it. The movements were all voluntary and seemed to be entirely under the child's control except when she attempted to walk; then the arm was held in this peculiar position with a slight tilting of the pelvis;

FIG. 1.

Aged nine years.

apparent shortening of about one inch of the right leg and a decided limp; no pain or atrophy, and no apparent interference with general health. The back was easily straightened by simply making a moderate extension of the right leg, and while the child was prone upon the table it would remain in this position indefinitely. The limbs of the upper and lower extremity could be moved in any

direction, either active or passive motion, with no change whatever in the position of the back. The moment the erect position was taken there was an immediate spasm of the muscles of the back and abdomen on the right side, and the tilting of the pelvis and the curving of the spine would again appear. This condition, the

FIG. 2.

Aged twenty years.

parents related, had existed more or less for a year—the child having been previously healthy—in fact, at that time seemed to be otherwise in excellent health. After a few weeks of constitutional treatment, together with gymnastics, directions were given as to diet, exercise, etc., and she returned to her home considerably improved, though not entirely relieved of the spasm and curvature.

Three years later, when nine years of age, she returned with the marked curvature of the spine and tilting of the pelvis, as is shown in Fig. 1, almost unable to walk, with the pelvis so tilted that there appeared to be three inches of shortening of the right leg; the spastic condition of the arm and forearm had not increased anywhere near in proportion to that of the right side of the muscles of the back and abdomen. The abdominal muscles were decidedly more rigid to the right of the linea alba than those of the left, and the abdominal viscera were pushed markedly to the left side. The child seemed perfectly normal mentally—in fact, had been attending school. The reflexes were not exaggerated. She was and had been at all times entirely free from pain, complaining only of fatigue after a long walk. There was little rotation of the vertebræ—that is, nothing like the rotation which would occur in such a marked curve in a case of scoliosis. While the greatest part of the curve seemed to be in the lower dorsal and lumbar regions, yet there was a curve extending from the seventh cervical and the full length of the spine to the left. Placing the child on the table, and with the hand pressed against the greatest convexity of curve, with the other hand on the opposite hip, the back could be thrown perfectly straight and held there without eliciting the slightest amount of pain. Regarding it now as an hysterical case the child was sent to a hospital, put to bed, and placed somewhat under the plan of treatment of the so-called "rest cure." Observing her closely at night, we could detect no change whatever in the deformity, even when in profound sleep. After a number of weeks of this treatment not the slightest change was observed as regards the contraction of the muscles and the deformity of the spine. An extension weight and pulley were applied to the apparently shortened leg, which soon overcame the contraction, and while applied held the back perfectly straight, but when she began walking again the deformity soon returned. Notwithstanding different forms of mechanical appliances that were used there did not seem to be any permanent improvement. During the entire time she enjoyed the best of health.

Fig. 2 is that of a case of lateral curvature and hysterical clubfoot in a girl, twenty years of age, typically neurotic; hysteria would at once be diagnosed. Years ago she was treated by a surgeon for hysterical dislocation of the hip, but had since gone the

rounds, so to speak, and had now a curving of the entire spine to the left, but most marked in the dorsolumbar region. There was a contraction and rigidity of the muscles of the back on the right side as well as of the abdominal muscles on the same side. From the tilting of the pelvis the leg was apparently four inches shorter than its fellow, and she claimed to be unable to walk without crutches. Fig. 3 shows the position of the foot, in which are contracted most

FIG. 3.

Showing hysterical club-foot.

markedly the tendo Achillis and the tibialis anticus. This case then being regarded as a typically hysterical one, she was isolated from her friends in a hospital, and by suggestion and mechanical manipulation the club-foot was quickly cured. The spine could be straightened by suspension or manipulation when the patient was in bed or on the examining table. No pain was complained of either during or after the severe manipulations of the spine, which were

necessary in order to overcome the deformity. These deformities remained the same during the waking and sleeping hours. Finally weight and pulley were applied to the apparently shortened leg, and not until after it was increased to eighteen pounds and worn for a number of weeks did the contracted muscles tire and allow the limb to be brought down even with the other. It was nearly six months after treatment was begun before the patient could be allowed up for any length of time without a return of the deformity. At times she had a temperature of 105° F., and again it was subnormal, all the time gaining in weight and seemingly enjoying perfect health. She left the hospital about two weeks ago with the club-foot cured and the tilting of the pelvis and the curvature of the spine markedly improved, though not cured.

It would seem that the conditions here presented must be differentiated from inflammatory disease of the vertebræ causing the muscular spasm and spastic paralysis. The lack of pain both in walking, and after the severe manipulations, together with the general condition of the patient, and the lack of any evidence whatever of organic change in the vertebræ, even after a number of years of malposition of the spine, would be sufficient to differentiate it from Pott's disease. The rigidity or spasm of the muscles was the only condition present which could possibly suggest spastic paralysis. It could not be confounded with true rotary lateral curvature of the spine, for there was only one long sweeping curve instead of the double curves, and not the rotation of the vertebræ existing in true lateral curvature.

OBSERVATIONS IN LATERAL CURVATURE OF THE SPINE.

Pathological. Clinical. Mechanical.

By A. M. PHELPS, M.D.,
NEW YORK.

Lateral curvature of the spine rises before us each year like a spectre. From every clinic in every country the orthopedic surgeon is deluging societies and medical journals with literature upon the subject. It is interesting to note that from the earliest records we can find upon the subject down to the present time the positive position taken by the author is only to be retreated from a year or two later. Then, again, we find in each quarter or half of a century the revival of ideas of the past, which ideas at the time they were published were considered absolutely correct, but after a very short time were relegated to the obscurity which they so justly deserved, only to be revived again by some enthusiastic orthopedic surgeon. Nearly all of the mechanical work, and part of the mechanical methods of support and gymnastics, advocated in this Association at the present time are only revivals of ideas which have run the gauntlet in centuries past. They have been tried, found wanting, and discredited, only to be revived again in a later century. I have visited the principal clinics of Europe and this country. I have spent a great deal of time with the various authors. I have found that they all agree and all differ. They all claim that they cure these cases, but, upon close investigation, I have yet to see the first case of lateral curvature of the spine in which bone change had taken place cured by any plan of treatment known to the scientific world. In these observations I find opinions varying all the way from those who advocate nothing but gymnastics; those who believe in gymnastics and mechanical treatment, to those who believe in mechanical

treatment alone. All claim equally as good results, but I note in most of the writings that the following statement is to be found: "The results were entirely satisfactory." I have often asked myself the question: "To whom?"

Now, here we stand with this problem confronting us—unsolved, treated in an empiric manner, running the same gauntlet of discussion and dispute as did congenital dislocation of the hip and causes of deformity in hip-joint disease.

It was this panorama which has appeared before us that has led me to present to you to-day the result of my observations in this peculiarly obscure deformity. Its cause is obscure, its pathology has been even more so, and its treatment in many instances even worse. I had firmly come to the conclusion that if we ever expected to arrive at a conclusion as regards the etiology, pathology, and treatment of lateral curvature of the spine it had to be done with the scalpel. I am frank to state to you that in the work which I have done with my assistants in the past two years has amounted to but very little; still it is something. It is along the lines which should be followed, in my opinion, and which will eventually lead to a solution of this problem.

It is extremely difficult to get subjects of lateral curvature of the spine for dissection, and until a great number have been dissected whose history is well known we will never advance in our work in lateral curvature of the spine.

I desire to-day to give you the work which, with the assistance of my staff at the Post-Graduate, we have performed. It is simply preliminary, and should be received for what it is worth, and no more.

Two years ago I secured a case of lateral curvature which died in the workhouse from natural causes. It was a severe form of lateral curvature of the spine. He had been there for many years, and no one could ascertain what caused his deformity. It had been with him as long as he could remember. A few years before he died he was afflicted with chronic rheumatism which resulted in contraction of one of his limbs, but there was no considerable joint disease. This case was taken to the dissecting-room of the Post-Graduate, and, with the assistance of Dr. Hendle, I dissected out the muscles of the back.

We found that the superficial layer of muscles, particularly the latissimus dorsi, trapezius, and the superficial layer of the erector

spinæ muscles were in fairly good condition upon the side of concavity, but upon the side of convexity there was not only atrophy but marked degeneration of the muscle. Fig. 1 shows these muscles,

FIG. 1.

and gives a very correct idea of what we found. The superficial group of erector spinæ muscles upon the side of convexity was entirely destroyed by atrophy and fatty degeneration, while those upon the side of concavity were not so much affected. These muscles were dissected

away, exposing what remained of the deeper layer of muscle. We found that the quadratus lumborum and the erector spinæ group of muscles of the deeper layers were entirely destroyed by fatty degeneration and atrophy on the side of convexity. On the side of con-

Fig. 2.

cavity the quadratus lumborum and the erector spinæ muscles, although somewhat degenerated, were not so far advanced as upon the side of convexity. This condition of the deeper layer of muscles was found all along the back to the seventh cervical vertebra—

throughout the region of the spine affected by the double curves. Fig. 2 shows dissection of what was left of deeper layer of muscles. Nothing but aponeuroses and a few muscle fibres were found. The intercostal muscles on the side of concavity had also undergone fatty degeneration where the ribs were still apart, but on that side the ribs had approximated and even overlapped, destroying entirely the intercostal muscles, binding the ribs together with firm fibrous material—remains of the intercostal muscles. On the side of convexity, however, the intercostal muscles were found to be also degenerated from pressure on account of the ribs being widely separated. This constant pulling upon the intercostal muscles made pressure upon the muscle cells by the approximation of the myolemma and resulted in atrophy almost if not quite to complete destruction. The intervertebral cartilages upon the side of convexity were entirely obliterated, the bodies of the vertebræ coming in contact one with the other. The transverse and articular processes were warped and twisted, the ligamentous connection between them being so shortened that dissection of them was practically impossible. Upon the convex side, however, the intervertebral cartilage was not totally destroyed. The transverse processes were widely separated and the articular facets on that side were slipped one by the other to a limited extent. The bodies of the vertebræ at the point of greatest curve upon the concave side were absorbed to one-half, and in some instances to the entire thickness of the vertebra. The pressure at these points had been so great that new bone had been thrown out to prevent further bending and absorption of the vertebræ. The muscles, or what was left of them, on the concave side of both curves were so shortened that it was an impossibility, with any force that we could apply, to make any perceptible effect upon the curves. It was not until after these fibrous bands, the remains of the muscles, were divided that any effect could be made. The thorax had already upon the right side (side of cavity) pressed upon the crest of the ilium, as is seen in Fig. 3, bending the ribs upward, forcing them together, lapping one upon the other. The efforts at respiration to increase the capacity of the thoracic cavity had resulted in the bending of the ribs upward anteriorly, which gave space between them in front. Notwithstanding, on the concave side they were tied firmly together and overlapping, while upon the convex side they were widely separated, as

is seen in Fig. 4. A side view, however, of the thorax shows the arching upward and bending downward of the lower ribs, produced by pressure upon the crest of the ilium, Figs. 5 and 6. The widely

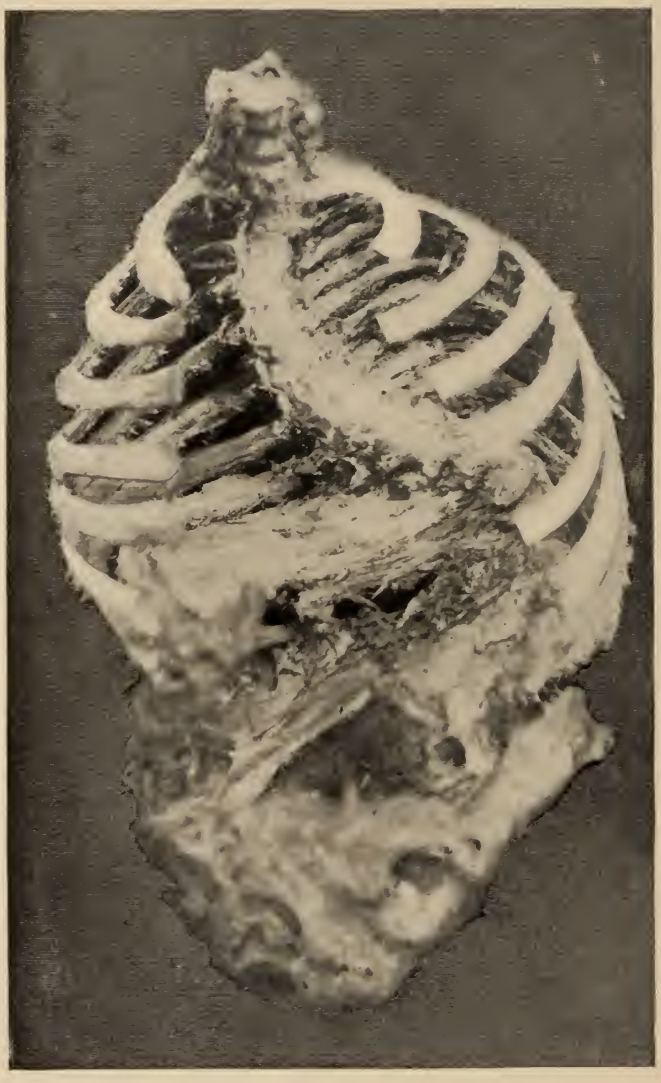
FIG. 3.

separated condition of these ribs is due to the convex curve of the vertebræ, as is seen in Fig. 5. The vertebra at each curve was rotated upon itself until the transverse processes pointed directly back, as is

FIG. 4.

seen in Fig. 6, taking the normal position of the spinous processes. The bodies of the vertebræ and the spinous processes pointed transversely instead of antero-posteriorly.

Fig. 5.



The conclusion at which we arrived from this specimen was this: There had been no evidences of paralysis or brain disease in the case. Therefore, that factor was left out of the question. We found

FIG. 6.

that the superficial group of muscles had acted upon the shoulders and trunk and moved the entire trunk *en masse*. The fatty degen-

eration and atrophy on the convex side was due to the pressure of the muscles by the bending of the bones of the spinal column, putting these groups of muscles on the stretch. Whereas, the degeneration and atrophy on the concave side was produced by the contraction of these muscles and their long disuse.

The entire trunk had telescoped together until the ribs rested upon the pelvis, which prevented any normal motion of the vertebral column. The bending of the ribs, their overlapping and firmly binding together by the fibrous remains of the intercostal muscles upon the concave side; the atrophy and degeneration of the intercostal muscles upon the convex side between the widely separated ribs, resulting in atrophy, told us that it would be an impossibility to remedy this deformity without first widely separating the ribs upon the concave side, which might allow the curve to be straightened, provided the deformed vertebræ did not prevent.

Assuming the fact that the thorax was not deformed in any way; that the ribs upon the concave side were not firmly bound together, and overlapping, by contracted intercostal muscles which had undergone degeneration, leaving only fibrous tissue, it would then be an impossibility to in any way straighten the curve on account of the destructive changes which had taken place in the vertebra and intervertebral cartilages, changing the plans of the articular surfaces of the bodies of the vertebræ. No matter how slight the change in the bones which had disturbed the equilibrium of the spinal column, thereby allowing the approximation of the ribs and shortening of the intercostal muscles upon that side, it would be an impossibility to straighten that curve until every rib had been detached from the other, and even then the spinal column would not stay in the perpendicular position, owing to the fact that the plane of the articular surfaces of the bodies of the vertebræ had been changed to an angle.

It was also observed that in proportion to the amount of curvature we found rotation, and that rotation took place in the direction of the curve, and in the lower curve that rotation had taken place until the vertebræ laid transversely to the body. The vertebræ being in this position had undergone change by absorption until it was wedge-shaped and warped. No force on earth short of fracturing the spinal column could have in any way changed the position of it. Now,

when lateral curvature of the spine, which is always accompanied by rotation, commences in the dorsal region, a corresponding change takes place in the shape of the ribs. When the change has once taken place, and bone has been destroyed by absorption, producing the curve, no means of which we know could in any way affect a restoration of the parts. It is a mechanical impossibility short of killing the patient.

These are the propositions and conclusions at which we arrived. We know perfectly well that in genu valgum associated with shortening of the external condyle, no bracing, however skilfully applied, can ever remedy that deformity. We also know that after the bones have become thoroughly consolidated that no amount of skilful bracing will cure the bowleg. While this may be possible during the time that the bones are soft, after they have become once thoroughly consolidated it is a practical impossibility. These facts have led the profession to adopt osteotomy and osteoclasia in remedying these deformities.

We have in the spinal column a complicated column. Instead of a straight shaft of bone, like the femur articulating with its tibia, we have here a combination of bones articulating closely posteriorly and laterally, and then attached to these bones are the ribs, the levers running out on either side from the upper to the lower dorsal vertebræ. The spinal column bends, producing destruction of bone and intervertebral cartilage, and by pressure the ribs are distorted and overlapping, and the muscular element between the ribs becomes changed by shortening, atrophy, and degeneration. So, how futile it must be to hope to cure a lateral curve of the spinal column. Not only do we find the resistance offered by the wedge-shaped bones of the vertebral column, but these distorted ribs must be rotated in order to cure the curve.

I leave this problem at this point and hope at some future date to go on with the work in other cases. Now, the conclusions at which we arrived from these dissections correspond very closely to the clinical observations which we made.

As I remarked at the beginning, I never saw a case of lateral curve and rotation due to destruction of bone from pressure, with corresponding deformity of rib, removed from the spinal column by any method.

My observations have been made in my own clinic and private practice, and also in the various clinics of this country and Europe, and they are that the most that we can hope for at the present time from treatment is to prevent (and that is not always possible) the increase of the curve, to remedy the physiological curve, and to give our patients, if possible, strength.

I visited Bernard Roth and spent some time with him and his work. I saw no different results in his work than what I saw in the work of many gentlemen in Europe and this country who advocate that nothing but gymnastics be used in these cases. None of his cases recovered. They grew stronger physically, but the curve remained. In the institution of Schilbaak, at Leipsic, where all sorts of gymnastics are used, and patients are placed in bed for hours each day after the gymnastic work, upon specially constructed beds, no cases are cured. In this country the gentlemen who have accepted the idea that gymnastics is all that is required in such cases tell me they do not cure their cases, that the most they can hope for is to give their patients strength and arrest the deformity and possibly improve the physiological curve. From the hands of some of these gentlemen many of their cases drift to my office and into my clinic. I find that the cases which come to me give the history of increased deformity. This leads me to believe that gymnastic treatment alone is one of the greatest fallacies that has ever been taught. So long as the patient is in the upright position the weight falls on the curves and produces further absorption of bone and distortion of the thorax. It is advocated by these gentlemen that gymnastics will strengthen the muscles and hold the spine erect. From this statement I must dissent, because the muscles do not hold the spine erect. The spine is held in the upright position on account of its anatomical construction and ligaments—the muscles balance. Muscles could not stand the strain of holding the spine in the upright position. If the arm is held at a right angle to the body, it soon tires and cannot be retained in that position. The muscles of the arm are not different from those connected with the spinal column. Therefore, the idea that the training of muscles will straighten these subjects is erroneous and not proven; it does not even prevent them from growing worse if the deviation from the median line has amounted to more than one-half of the diameter of the vertebra.

All that can be accomplished by gymnastics is upon the constitution of the patient.

Now, in regard to the various machines that have been devised in the past three hundred years, revived from time to time and presented to the profession, I can only say of them as I say of gymnastics: They can have no possible effect upon the curves and the rotations *per se*. The only possible good they can do is to assist in holding up the spine, but so long as the ribs are bound together by contracted intercostal muscles that force can be of but little avail. Whereas, under an anæsthetic, force applied so strong as to fall short of breaking the ribs might be of some use, provided the vertebral column was held in the corrected position after the force was applied.

This leads me to the consideration of the proper mechanical treatment of lateral curvature of the spine; and, believe me, gentlemen, it is all, or nearly so, a question of mechanics.

Under an anæsthetic great force can be applied, so great that the patient could not possibly endure it without. While the patient is under the anæsthetic this tremendous force can be applied to the thorax and spine, either by machinery or by half a dozen hands, and any muscles or fascia which offer resistance can, under these circumstances, be divided with a knife. In this manner I have succeeded in taking a great portion of the curve out of the spinal column; but even with all of this, I have never yet succeeded in straightening a curve in which bone change had taken place. After the operation the patients are enveloped in plaster-of-Paris, put to bed and kept there for two or three weeks, after which the operation is repeated. This, it seems to me, is the only operation to be advocated in lateral curvature of the spine.

The specimens which I have dissected seem to demonstrate this, and clinical observation verifies it without a doubt. Then comes the question, what is to be done after the curve has been remedied so far as possible by great force under an anæsthetic and the muscles have been divided with the knife? When the patient is convalescing, there is no question in my mind but that the suspension of that patient and the application of a proper support should be the law. Inasmuch as the force of a support must exercise pressure varying from twenty-five to one hundred pounds, depending upon the size of the patient, it would stand to reason that the support

which made pressure on the greatest possible surface of the body would be the one to choose. Steel braces could not be borne under these circumstances, and, in my opinion, should not be used.

Therefore, any support which has for its object an antero-posterior action is scientifically wrong in any lateral condition, whether in lateral curvature or Pott's disease.

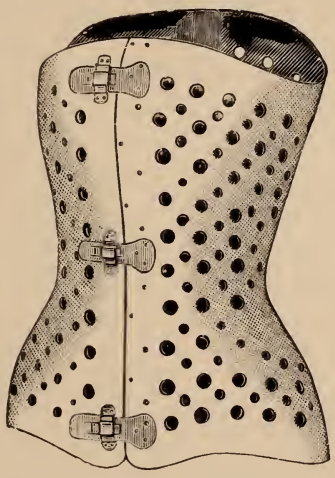
The mechanical support for lateral curvature of the spine should be as rigid as an oak, because it is dealing with a rigid spine. It should be light. It should be porous. It should be durable. The plaster-of-Paris corset comes the nearest to these requirements of any of the cheap dressings. Poroplastic felt, leather, raw hide, and paper do not fill these requirements, because they will change their shape under pressure and moisture. They should never be used for spinal supports. I have tried them all, and I know whereof I speak. I have seen patients shortening in the summer time in a single week. Celluloid is worse, because it will not hold its shape for forty-eight hours; and the wood corset is absolutely worthless. I advise the aluminium corset, which, to my mind, is the most perfect support ever devised. The patient can go in bathing without taking off the support.

Now, in regard to gymnastics. To change the form of the thorax, which will aid materially in somewhat alleviating the curves, breathing exercises which expand the chest, elevating the ribs, which applies a force direct to the spinal column, assist materially. Exercises should be done while the corset is on. It is wrong to take it off. The physiological curve can only be overcome by constant support and muscular development, and the pathological lateral curve by preventing the patient from assuming the erect position without his corset. Light gymnastics are far preferable to heavy. Heavy gymnastics develop muscle, but no quicker or surer than light gymnastics. We can learn a very important lesson from the sporting world, where heavy gymnastics have been entirely discarded. Muscles developed by heavy gymnastics undergo rapid degeneration when the gymnastics are stopped.

I offer the aluminium corset, Fig. 7, as a substitute for many of the braces and corsets now worn in the acute form of Pott's disease and lateral curvature. I suggest it to take the place of such braces in cases requiring permanent bracing, or in individuals who are desirous of securing a support at any time which combines durability

with lightness and comfort. So soon as a case of lateral curvature has been arrested, or the greatest amount of benefit has been derived from treatment, the aluminium corset will then be found a

FIG. 7.



most agreeable, permanent support. The aluminium corset has these qualities to recommend it to the patient:

1. Lightness.
2. Durability.
3. It is thin and does not interfere with the form and clothing.
4. Being extensively perforated makes it the coolest and most agreeable of supports.
5. The patient can wear it during bathing.

An ordinary corset weighs from one to two pounds, depending upon the size. To prevent cracking and to protect it from perspiration it is covered with a water-proof enamel, which is applied by heat.

The steps of its construction: Make a plaster form of the body; send this form to the foundry and have a cast-iron anvil made; polish this, and then at a certain temperature the workmen will bend on to it two sheets of aluminium representing the two lateral halves. The frequent heating and hammering, together with the cylindrical shape, make the corset almost as strong as steel. The two halves are hinged in the back and closed with automatic clasps in front,

which stop at any notch to accommodate itself to the body before and after eating. This corset completes my armamentarium in cases requiring spinal supports, viz. :

1. Plaster-of-Paris corsets for acute Pott's disease.

2. The Hessing corset for mild forms of lateral curvature, particularly in girls.

3. The aluminium for permanent bracing.

The wood, celluloid, paper, wire, leather, and felt corsets are worthless. They change in shape and do not support the spine.

I am sorry that this paper is incomplete. It has told but little. It has told something. It is the beginning of a work which I hope others will assist in. I have no doubt that if these lines are followed out for the next twenty-five years the problem of lateral curvature will be solved.

DISCUSSION.

Dr. E. H. Bradford, of Boston, said that Dr. Phelps' statements were frank, straightforward, and well-thought out, but they were not entirely convincing. Suppose one hundred years ago a surgeon had reported on a case of Pott's disease in this manner, the only conclusion must have been that it was utterly impossible to treat Pott's disease! Lateral curvature is a change in the bones, and, in the final stages, the bone is hopelessly changed. He agreed entirely with Dr. Phelps regarding the pathology, but he claimed that there was a stage in which lateral curvature could be changed and benefited. There were certainly some cases in growing children which were benefited by treatment. This Association should not take the position that lateral curvature is a hopeless deformity.

Dr. L. A. Weigel, of Rochester, N. Y., said that orthopedic surgeons recognized the fact that in all cases of lateral curvature the normal flexibility of the spine is interfered with. If the hinderance to normal flexibility was caused by muscular contraction or shortening of the concave side, and he believed it was, then he could not agree with Dr. Phelps that it was necessary to do a myotomy to overcome this condition. We have in our possession powerful me-

chanical means for overcoming such contractions. He had time and again seen patients with muscles on the concave side as rigid as a bar of iron, in which absolute relaxation had been secured by forcible stretching. Restoration of normal flexibility is the first step toward correction of a distorted spine. He thoroughly agreed with Dr. Bradford, that if these cases were properly treated at an early stage it was possible to restore the spine to practically normal condition.

Dr. N. M. Shaffer, of New York, said if there was any one thing clear in his mind it was that lateral curvature is dependent primarily not on bone changes, but on changes in the muscles. In cases of lateral curvature due to poliomyelitis, for example, the chief cause is found to be a muscular one, and probably underlying this was a condition of the nervous system. He believed if the curve were fixed and rigid it was extremely doubtful if much good could be accomplished, but he was positive, from personal experience, that the less advanced cases could be benefited and slighter curvature could be absolutely cured. Reference was made to two cases. One of these was a man, twenty-eight years of age, who had bowlegs due to changes which took place at the internal condyle. At the end of the year there was a separation of over six inches as he walked. By wearing a slight support, the distance was not only an inch and a half, and his bowlegs had been practically cured. In another case, one of coxa vara, he had applied a perineal support, and at the end of a year the distance had been reduced from one and a quarter to half an inch.

Dr. H. Augustus Wilson, of Philadelphia, suggested the possibility that asymmetrical hip action in apparently normal subjects might result in lateral curvature. In a number of cases of scoliosis he had found that there was a decidedly asymmetrical action of the hips, although the latter were apparently perfectly normal. A compensatory movement takes place in the third hip-joint—*i. e.*, the lumbar vertebræ. He offered this thought as a suggestion of one etiological element of scoliosis.

Dr. A. B. Judson, of New York, complimented Dr. Lovett on his ingenious study of this difficult subject. He had been especially

interested in the conclusion reached by Dr. Lovett that in prophylaxis and treatment it was important to secure and maintain the spine in a position of extension at the seat of the deformity. The speaker said that a few years ago he had advocated (*Transactions of the New York Academy of Medicine,* 1876, p. 330), and in one case had practised, the application of a spinal brace for the production of extreme lordosis in cases of lateral curvature, on the ground that as in rotation the anterior part of the column was affected by deviation from the median line just as it was affected by caries in Pott's disease, it was good practice to shift the weight of the body from the anterior to the posterior part of the column. For some reason or other he had not continued the practice; but as Dr. Lovett had reached a similar view, although from another stand-point, he now believed that the method promised great advantages.

Dr. Phelps, referring to Dr. Lovett's paper, said that in 1888 he had made investigations clinically with similar results, and in one case in particular he had called in Dr. Judson to examine a case in which there was curvature of the spine in one direction and rotation in the other. This photograph he presented to the Association with the explanation upon the back of it written by Dr. Judson, giving his opinion of the case. Dr. Phelps at that time stated to Dr. Judson that he believed in these cases of extreme lordosis the curve would be in one direction and rotation in the other. From this Dr. Judson dissented, and he wrote his opinion upon the back of the photograph which was presented to the Association.

DEFORMITIES, CONGENITAL MULTIPLE—ARMS AND LEGS—FEMURS DEFICIENT.

By De FOREST WILLARD, M.D.,
PHILADELPHIA.

The subject of this sketch was, when first seen, six years of age. His mother had previously had one stillborn child, perfectly formed. There were no deformities in either of the parents' families. The father had had several children by two previous wives; no deformities. Labor with this child was normal; no known injury during pregnancy; no known maternal impressions. Head and trunk of the child were naturally developed, and of good size, rather large. As will be seen by the photograph, his position standing was in the squatting posture, with the buttocks only four and one-half inches from the floor. (Fig. 1.) The thighs, from the congenital deficiency of the femurs, were so short that the distance from the perineum to the inner condyle was only one-half inch on the left side and one inch on the right. From the anterior superior spine to the knee when flexed, three inches; extended, four inches. The right acetabulum was deformed so that the distorted upper end of the shaft of the femur slipped upon the ilium. The head and neck of the femurs were poorly developed. The junction of the thigh to the body presented a peculiar appearance; there was no groin fissure; the perineum was very wide and deep, and the anus was near the posterior border of the scrotum. The scrotum in standing hung opposite the middle third of the tibia. By muscular effort he could for a moment or two straighten his knees and hips so as to raise himself five inches, but immediately sank again into the squatting posture with the posterior part of his thighs resting upon the calves, in which position

he walked. The total height was twenty-nine and one-half inches, of which the body constituted twenty-four and one-half inches. The best position to which he could bring his thighs was to 135°, and then only by the production of a lordosis. Right leg from

FIG. 1.

Congenital deficiency of bones. Best possible walking position. Buttocks four and one-half inches from floor.

the knee to the sole of the foot was ten and one-half inches ; left, eight and one-half. The left tibia was bowed anteriorly, with apparently cicatricial tissue at its greatest point of anterior curve. The left patella and fibula were absent. Left foot was in the

equino-valgic position as he walked upon the tip of the three toes bending the ankle badly inward at each step. The first toe was large and distorted, apparently a conjunction of the first and second; the third and fourth were present, but the fifth was absent. The

Fig. 2.

Congenital absence of fingers and toes.

right foot had four toes and four metatarsal bones, the outer one being a fusion of the fourth and fifth, the middle toes being webbed. (Fig. 2.)

When the boy was first seen, skiagraphy had not been discovered, but I have recently had an X-ray representation made of the hands

FIG. 3.

Skiagraph of hands and feet. Absent metacarpal, metatarsal, and phalangeal bones. Distortion of left calcaneum and tarsus.

and feet, which shows the fusions and deficiencies in the metacarpus and metatarsus. (Fig. 3.)

Left hand and arm perfect. Right perfect except the hand, from which the first finger was absent; the middle finger was

FIG. 4.

Usual walking position when in haste.

large, probably a fusion of the first and second digits; ball of hand narrow; ring finger short and small, extending only to the second joint of the others, one-third the size, and one-half webbed with its neighbor on the outer side.

Locomotion in the upright position was so difficult that he progressed much easier on all-fours, and usually went either on a gallop or trot, his strong arms and body enabling him by this method to move quite rapidly. When he was in haste he either trotted upon all-fours, or, inverting his body, would run upon his hands. (Fig. 4.) His arms were unusually developed, and with his light lower extremities he could walk upon his hands, with his body in

FIG. 5.

Congenital deficiency of legs. Child able to run upon its hands, with body in the horizontal position and with legs elevated from floor.

the horizontal position; could even in this posture lower himself slowly to the ground and raise himself—a feat which would be impossible even to an acrobat. (Fig. 5.)

Of course, operative measures could not increase the length of the femurs, but their flexion upon the pelvis was overcome by open section of the tensor vaginæ femoris and rectus muscles upon either side. An osteotomy through the middle third of the anterior curve of the left tibia was performed, which, together with tenotomy of

the tendo Achillis, hamstrings, and peroneal, brought the left foot and leg into much better position, and resulted, together with the adaptation of apparatus, in bringing his buttocks in standing eleven and three-eighths inches from the floor, which increased his total

FIG. 6.

Congenital deficiency of bones. Result after osteotomies and myotomies. Body raised nine inches.

height to thirty-five and three-eighths inches—a gain of over nine inches. (Fig. 6.) His left leg was lengthened by the addition of a cork sole to equal its fellow, but the flexion of the thighs could not be entirely overcome.

Fig. 7 is the skiagraph of a child, two years of age, with a deficiency of the entire lower end of the tibia, and with absence, or cartilaginous condition, of the tarsus. The foot is attached to the

FIG. 7.

Congenital deficiency of lower end of tibia and of tarsal bones.

tibia at the middle of the leg. Over the projecting point of the spine of the tibia is tissue which is cicatricial in appearance. The child is otherwise perfectly normal.

SPINAL CARIES PARAPLEGIA; FORCIBLE REDUCTION IN A LONG-STANDING CASE; IMMEDIATE BENEFIT AND RAPID RECOVERY.

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C. B., aged four years, was the subject of spinal caries in mid-dorsal region at the age of two, which progressed without treatment, and in a few months he became a total paraplegic. On admission to the orthopedic ward of the University Hospital he had been unable to walk for eighteen months; there was a very long and large arched kyphosis extending from the fifth to the tenth dorsal vertebræ, which curvature was not, however, at any point acutely angular. There was total loss of motion; not even a toe could be moved voluntarily; the legs were rigid; there was fixation at the hips and knees; the muscles failed to respond in either leg to galvanic or faradic currents; sensation was practically *nil;* both urine and feces were passed without any knowledge of the patient; there were frequent attacks of priapism, and large bed-sores had formed over the sacrum, ilium and trochanters.

His condition was most serious; anæmia was marked, and nutrition exceedingly poor. The indications were those of speedy dissolution. He was placed upon a water-bed and horizontal extension applied by weights to both legs and head; later a plaster jacket was applied to fix the spine. Under this treatment, together with iodide of potassium, tonics, etc., and placing him in the sunshine and fresh air daily, his general condition improved, but after two years there was no gain in either motion or sensation.

Although the operation of forcible straightening of the spine in caries is in my opinion an unsurgical procedure, calculated in the majority of cases to do more harm than good, yet I felt that in

this case it was certainly justifiable. The boy was therefore etherized, placed upon his face, his pelvis and thorax supported upon large sand bags, and forcible hand pressure made upon the kyphosis until the spine cracked and visibly straightened. The body was then, while in the prone position, fixed in a plaster-of-Paris corset, and extension made upon the legs. In one week's time slight evidence of sensation was apparent in the limbs, which sensation steadily increased. Motion returned in two weeks from the time of operation. In three weeks he began to voluntarily move his limbs and to control his bladder and rectum. He was then sent to the orthopedic gymnasium connected with the ward, for mechanical massage, manual massage, electricity, and the voluntary use of bicycle and other machines for the development of muscular leg motion. Here he was treated for six months, and at the end of that time was discharged, still wearing the spinal support, but able to walk up stairs without assistance. The gain in the curvature of the spine was not more than 15°.

This case was apparently one of the most hopeless ones. Thorough, careful, and continuous medicinal and mechanical treatment had been employed for two years without benefit, and if the immediate improvement after the operation was a coincidence, it certainly was remarkable. As already stated, I do not believe that Calot's method should be employed save in carefully selected cases. We know that a solid spinal column can only be secured, after destruction of the bodies, by deposition of bony bands, which deposit alone can give strength to this supporting column. The continuous effort of the muscles to secure rigidity in a failing spine is most remarkable, but muscles must ultimately yield, and real cure can only be accomplished by bony deposit. To widen this anterior carious gap by fracture of its supporting elements is to add an inflammatory process to the already existing tubercular disintegration and invite suppuration and failure of the strengthening process. In old hopeless cases, however, like the one mentioned, and with a judicious exercise of force, there is a small and limited field for this operation.

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